

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 230 No. 4707 • 30 December 2022 - 12 January 2023

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Waterwheel Clock

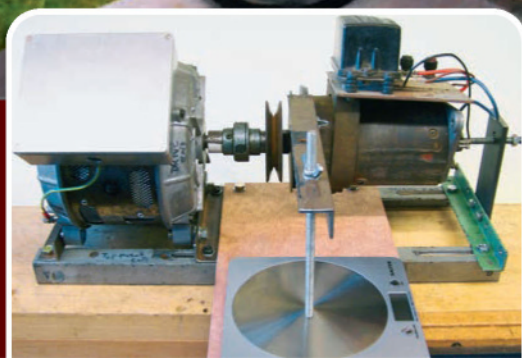
An interesting
variation on the
skeleton clock

LOWMEX 2022

East Anglia's
own model
engineering show

2½" LNER A4

Battered A3 restored
and repurposed



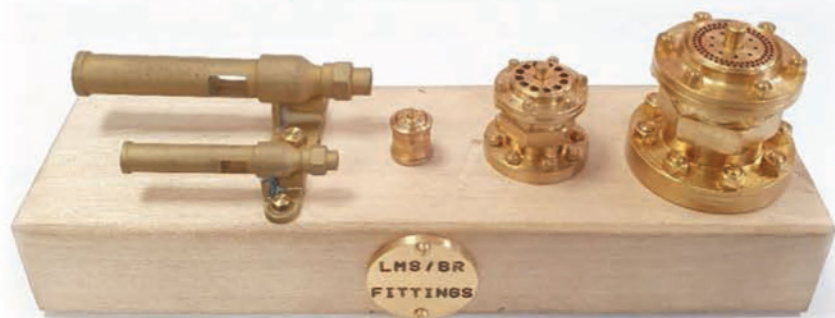
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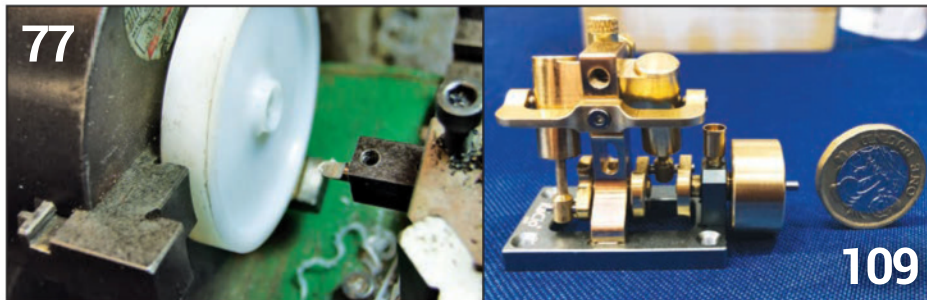
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Ian Couchman's 'hit and miss' internal combustion engine (photo: Ian Couchman).



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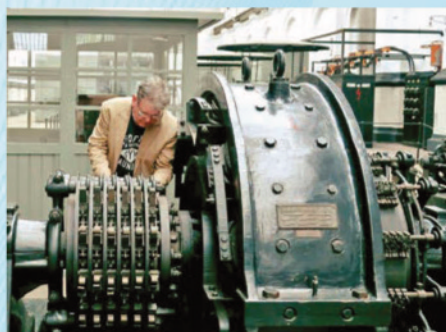


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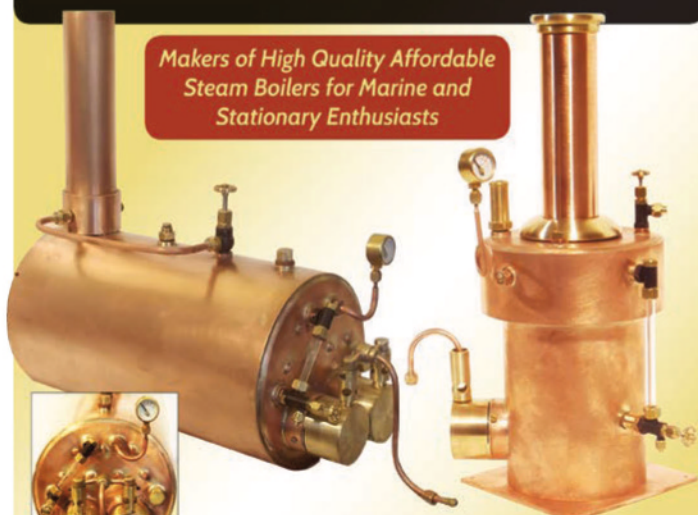
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a Wonderful Project for 2023!

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"Stella" the NEW construction manual from Peter Scott, designer of 'Ephraim' and is in stock.

Hot air engine powered locomotives never existed in reality, but in model form they have the considerable benefit of no boiler to build and test and "Stella" will run for long periods without any attention, on a small filling of methylated spirit. The prototype "Stella" will happily pull half a brick on a standard truck, so is unusually powerful for this type of locomotive.

Hot air engines do require careful work to build, to avoid unnecessary friction, and, whilst they can be built by a beginner who has access to suitable equipment, he or she will find it easier if they can obtain advice and help from an experienced model engineer.



The engine unit may be built on its own, and will function perfectly well as a stationary engine. It could also be adapted to become a hot air engine powered traction engine or steam lorry.

Laser-cut parts are in development and will be available shortly. 88 page paperback with full drawings and vast numbers of photographs of machining set-ups.

A lovely and interesting project for 2023!

and a Delightful Read for the winter months:

Thunderbolt's Last Run • Young • £14.80

When last seen back in 1953, or on TV screens most weeks since, the 'Titfield Thunderbolt' had triumphantly reached Mallingford to secure the licence to operate of the Titfield branch. But what happened next?

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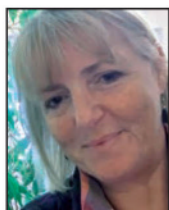
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Designer

Happy New Year

Let's hope so! This year started rather badly, with Putin's disastrous invasion of Ukraine. This led to rising fuel prices and, consequently, rising inflation. These two factors were not without consequences, of course, and were compounded by freezing cold weather earlier this month (now somewhat abated, mercifully) and what we will, I am sure, come to recognise as the Christmas 2022 General Strike. Add to this the extra pressure on social services of uncontrolled, and apparently unstoppable, immigration, and a health service that is buckling under the strain of it all, as well as the aftermath of covid, and we have a year that is truly going out with a groan.

With all this, what can I say about next year? My usually dependable crystal balls,



David Goyder's rather beautiful Princess of Wales, expertly driven at the rally by Tom Parham.

Vriesyanutsov

Some of you will know that, every year, Brent Hudson runs a rally at his railway near Cambridge in commemoration of the celebrated Siberian locomotive engineer Vriesyanutsov. I was privileged to attend the rally this year, in early December, and I can confirm that it certainly lived up to its name. Despite this, it was very well attended with a nice collection of fine locomotives in steam, along with a not so nice collection of random Diesels (my prejudices are showing!). The rally had everything – chaos in the signal box, locomotives falling off on the corners and a derailed train of Pullman cars – and a great time was had by all.



Dave and Lily Scott anticipate a busy and productive new year (photo: Dave Scott).

I'm afraid, have failed me on this occasion but I think it's reasonable to suppose that it can't get much worse. So – on that basis – I wish all our readers a rather better and, I hope, happy new year.

A New Show

One piece of good news about 2023 is that there is to be a new model engineering show. It is now 'official' that the Harrogate show is all set to be revived. The National Model Engineering Exhibition will take place at the Great Yorkshire Showground in Harrogate on the 10th and 11th of March. This is great news after the demise of the Alexandra Palace and Doncaster shows. There is a date to enter into your brand new, optimistic 2023 diary!

Cock-up Corner

Yes – again!

In our Midlands competition report (M.E.4704, November 18th) we mentioned a Stuart S50 engine in class 5 that was commended by the judges. We reported this as having been made by John Fysh. It was in fact made by John Wing. My apologies to Mr Wing.

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
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Clock, dome removed.



Ball lifting arm in motion.

Eric Rumbo
presents his
own version
of a skeleton clock.



A Waterwheel Skeleton Clock PART 1

Starting April 2002 *Model Engineer* published a construction series for a 'Ferris Wheel' skeleton clock by Richard Stephen. Although not involved in clockmaking at the time I followed the series and wondered why the Ferris wheel was not made concentric with the minute arbor. It would have meant a more attractive arrangement with the balls, not half hidden, but surrounding the dial. I also thought that 'Waterwheel Clock' would be a more accurate description for this type of clock.

Having subsequently picked up the clockmaking bug I decided, in 2019, to design and build my own skeleton clock and this led me to take a second look at Stephen's. I began by reconfiguring it to make the Ferris/waterwheel (henceforth referred to as a 'cage') concentric with the minute arbor and this modification suggested a much simpler method for lifting the balls. A free-to-rotate arm behind the cage, with offset containers at each end, would collect a ball when it falls

and immediately rotate 180 degrees and return it to the top. Except for the few seconds whilst a ball is being raised, the mechanism would be hidden – see **photos 1 and 2**.

What follows is a description of the clock but not of each individual component. Techniques, such as wheel and pinion cutting, bluing of screws and hands, etc., have also been dealt with in many clockmaking books and articles and it is pointless to repeat them. I concentrate on the salient

aspects of this clock with machining information where appropriate and where I have developed unique ways for tackling some of the tasks. An experienced clockmaker or model engineer should be able to work out the rest. Anyone requiring more information could perhaps contact *Model Engineer* and ask them for my email address.

Dimensions - dome, plates and pillars

The internal dimensions of the dome, purchased from an antique shop, were diameter 198mm and height 345mm and the clock was designed to fit. An 'A' shape was chosen for the front and back plates and there is an intermediate plate dividing the timing section, at the rear of the clock, from the balls cage and lifting arm. The plates are 5mm thick engraving brass with seven pillars holding them together (**photo 3**). Front and back plates are 100mm wide at the bottom, 40mm at the top and 237mm tall. The separation between the front and back plates is 78mm (two pillars), with the intermediate plate 48mm from the front (two pillars) and 25mm from the back (three pillars). The plates were machined to shape from the start but the skeletonising was left till the end.

The going (timing) train

The minute arbor is located at the centre of the front/back plates and the going train spaced vertically from it. The arbor, 5mm diameter brass, is reduced at each end to fit flanged ball races, outside diameter 8mm and inside diameter 4mm, fitted to both back and front plates. The other arbors, 3mm brass, run on miniature ball races, outside diameter 5mm and inside diameter 1.5mm, inserted into cavities in the back and intermediate plates. The teeth on wheels and leaves on pinions are 0.6 module and of epicycloidal form. The minute wheel has 96 teeth and the intermediate wheel 90. Pinions have 8 leaves.

Establishing the optimum separation ('depthing') between wheels and pinions is essential for proper running of a clock. The traditional method employs a clockmaker's depthing tool but a simpler device usually suffices for the amateur clock maker. See the 'clickspring' website for an excellent video. There is no reason why this depthing technique should not be used for this clock. That said, previous to this clock, I had developed my own system for planting wheels and pinions on a vertical mill/drill which I have used for three different clocks with excellent results.

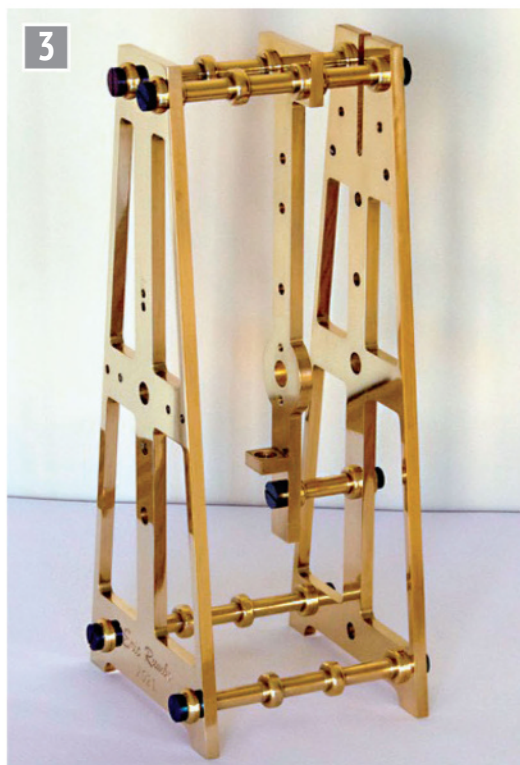
It required making an attachment for the mill. **Photograph 4** shows the device in use on a different clock and **photo 5** is an exploded view of its components. Temporary arbors are machined to fit the wheels to holes in the plates and the pinions to the attachment. The plates are bolted together with short spacers (~6mm) instead of the pillars, raised on 25mm blocks, and bolted to the mill's bed. By rotating the wheel and moving the slides on the mill the best engagement with

the pinion can be found. The slides are then locked, the device replaced by a drilling chuck and the plates drilled and reamed 4mm. The process is then repeated for the subsequent wheels in the train. The cavities for the miniature bearings are opened up with a 5mm 2 flute milling cutter.

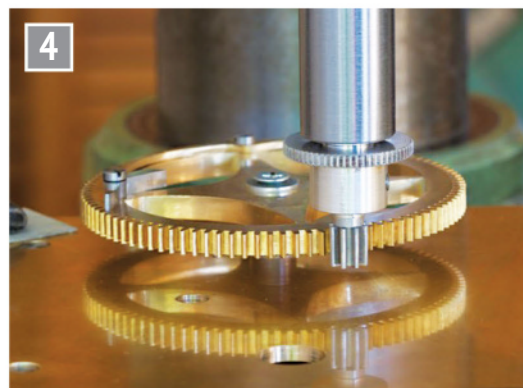
Compared with most clocks the depthing is slightly more complicated because the minute arbor connects the back and front plates whereas the arbors on the intermediate and escape wheels connect the back and intermediate plates. I proceeded by clamping together all three plates with the intermediate on top and drilling and reaming the four holes for the pillars at the corners followed by a 4mm hole at the minute arbor location. The front plate was removed and the intermediate and back plates clamped using plugs to align the three holes on the intermediate plate with the back plate. The holes for the seventh pillar were then drilled and reamed. The intermediate and escape wheel were then planted using the method described above. The 4mm holes at the minute arbor location were later enlarged

to 8mm in the front and back plates to fit the flanged ball races and $\frac{5}{16}$ inch in the intermediate plate for a tube around which the balls cage and ball lifting arm rotate. The reason for the mixed imperial and metric sizes is simple - I already had the ball races left over from earlier projects.

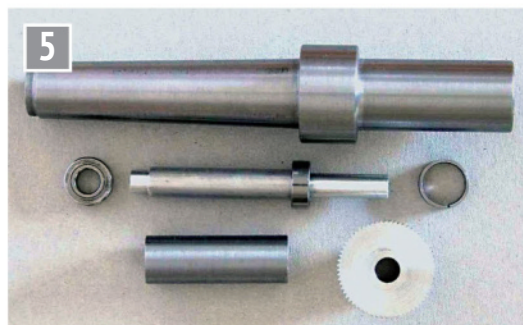
The escapement is deadbeat following Britten's *Watch & Clock Maker's Handbook* for a wheel with 30 teeth and an anchor spanning 9 teeth. The teeth on the escape wheel are inclined 10 degrees with respect to a radial line joining the tip to the centre and a further 12 degrees determines the thickness. Cutters are available which will produce the teeth profile in one pass but they are expensive and specific for wheel diameter and tooth count, making it difficult to justify since they may never be used again. Hobbyists often resort to using fly cutters ground to shape. The problem with this approach is that the teeth for a small diameter wheel are very thin and the highly intermittent action of a fly cutter can end up in distorted teeth. My approach uses a slitting saw and is applicable to any



The framework.



Depthing on the milling machine



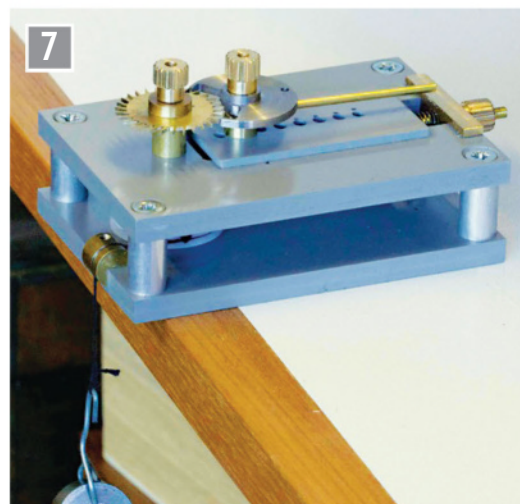
Exploded depthing attachment.

Establishing the optimum separation between wheels and pinions is essential for proper running of a clock.

The traditional method employs a clockmaker's depthing tool but a simpler device usually suffices for the amateur clock maker.



Machining the anchor, step one.



Testing the anchor/escape wheel engagement.

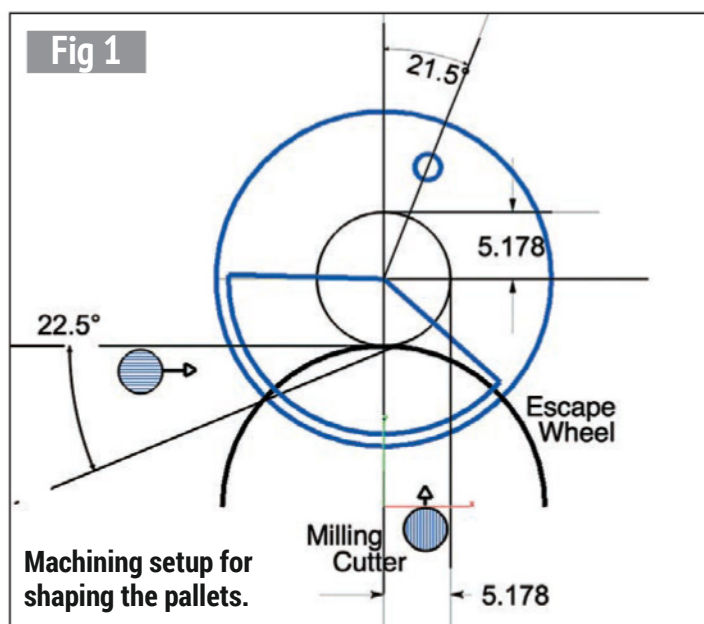
wheel diameter and number of teeth. It simply requires some trigonometry to implement and two passes instead of a single pass with the cutter. It produces teeth with a mirror finish and no distortion.

I chose 1mm thick engraving brass and a wheel diameter of 25mm. The blank was fitted to a dividing head on the milling machine configured to step 12 degrees. The slitting saw, 0.8mm thickness, was aligned with its top surface at the level of the centre of the blanks and then offset vertically to produce the 10 degree angle for the first pass of the saw. That completed it was then raised further so that the reference cutting surface was now the bottom at an angle of 22 degrees with the radial line. The blank was rotated to allow for ~0.2mm thickness at the tips of the teeth. A second pass removed the remaining metal leaving the required tooth profile. The space between the teeth will not be a smooth circle so a small amount of filing tidied up. As with the other wheels on the clock the escape was crossed on a rotary table on the vertical milling machine using a 1mm cutter.

The anchor was made from a slice of silver steel rod, centre drilled and turned to the outside diameter of the pallets as prescribed by the Britten diagram for a 25mm escape wheel. The cavity shown on **photo 6** was then carved out on a rotary table using a four-

flute tungsten carbide milling bit to leave the thickness required for the anchor pallets and the angle for the arms of the anchor. A hole was drilled on the opposite side to use as an angular reference. Both the inner and outer surfaces of the pallets were then polished, it being easier to polish the surfaces now rather than the short pallets on the completed anchor.

Figure 1 is a simplified version of Britten's drawing showing the dimensions and angles that need to be followed to remove material and leaving the pallets. The cutter should be moved at least 0.1mm from the nominal measurement to allow for polishing the ends of the pallets. The gadget shown on **photo 7** was used to test the engagement between wheel and anchor. The separation was then used to position the escape wheel

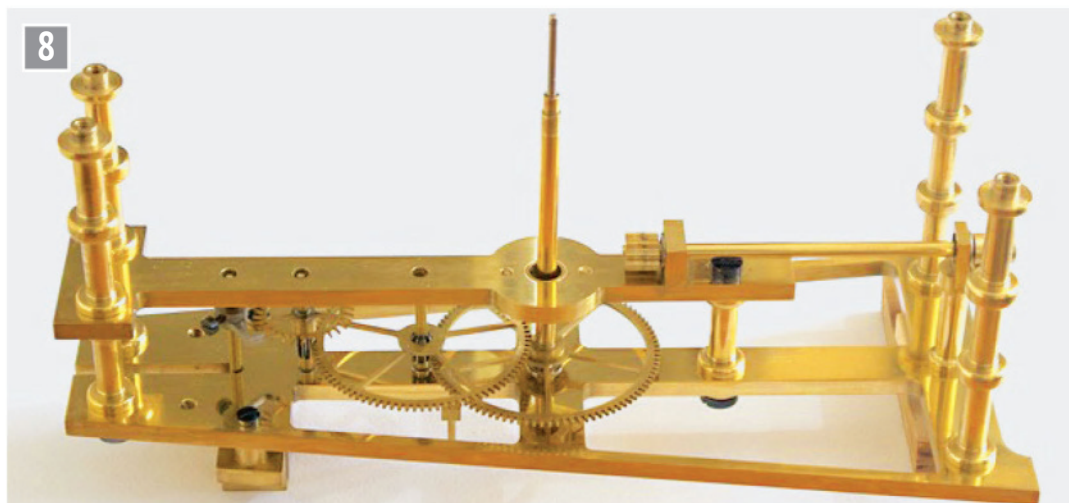


arbor on the clock, running on miniature bearings between the intermediate plate and the backcock. The remaining shape of the anchor was machined on the mill and the

ends of the pallets hardened by heating to a red colour and quenching in oil.

The completed going train is shown in **photo 8**.

● To be continued.



The planted going train.

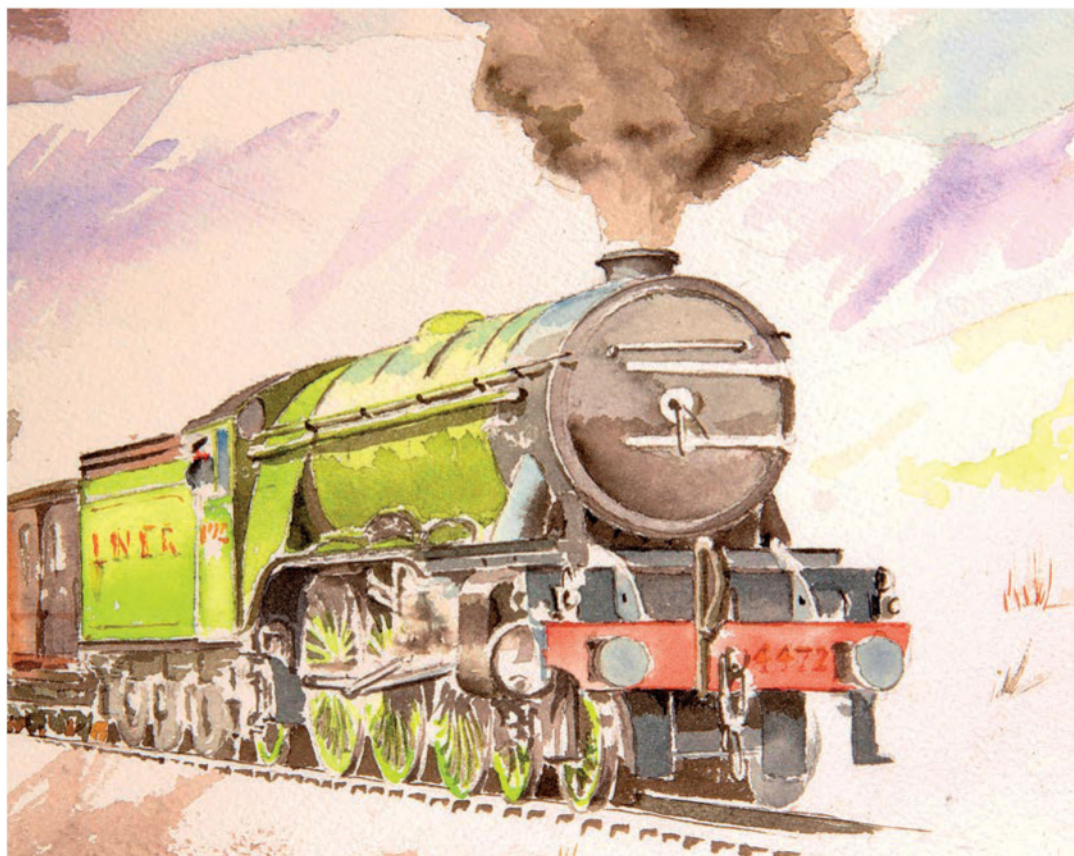
Peter Seymour-Howell

builds a fine, fully detailed model of Gresley's iconic locomotive to Don Young's drawings.



Continued from p.754
M.E. 4705, 2 December 2022

PART 49 – FITTING THE CYLINDERS



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge



1. The first job was to finish off the exhaust passageway from the cylinder through the flange and into the saddle.

The exhaust is directed up from the outside cylinders into the saddle and thus to obtain good flow the cut outs through the flange needed to be angled, at approximately 45 degrees. The cut outs in the frames were angled long ago but I still needed to remove some metal from the cylinders themselves.

Fitting the cylinders

I have left the final fitting of the valves (described last time) until the connecting

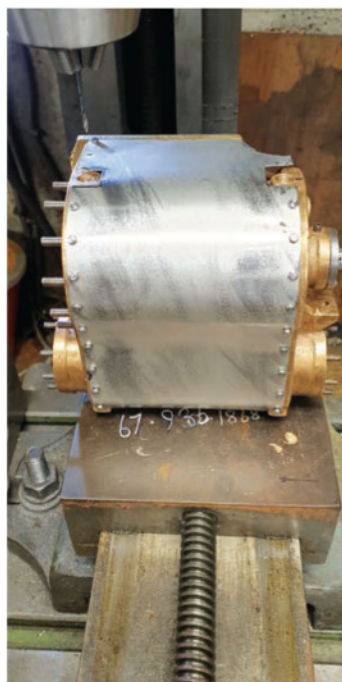
rods, crossheads and bearings have been made and before they can be fitted the cylinders and the slide



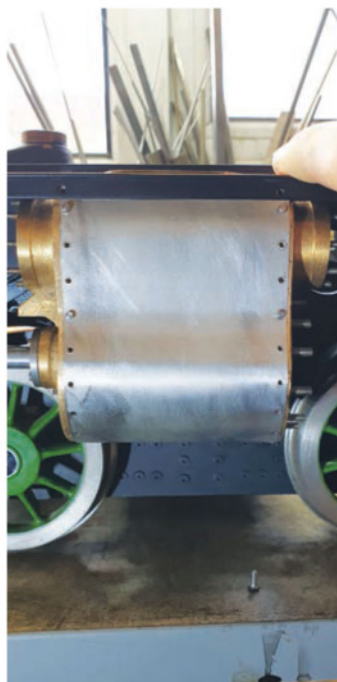
2. Before refitting the flange for the last time, I sealed the area around the exhaust with high temperature silicone. I'll use the same when fitting the cylinders to frames and also when the saddle is fitted for the last time.



3. There are plenty of photographs of the full-size engine with big dents in its cladding - problem is it would not look at all good on a model and the 10 thou brass I was going to use will dent very easily. I have therefore changed the brass for 13 thou tin which is much tougher. Here is the original cladding.



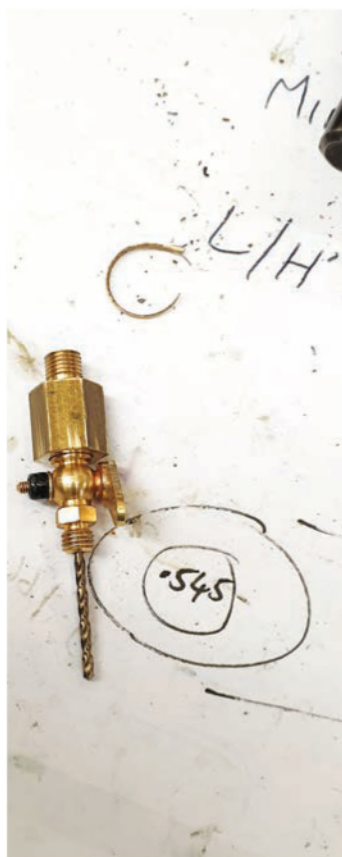
LEFT: 4. The first job was to shape the cladding, this time from tin to give a stronger article and less likely to get dented. I shaped the cladding partly by hand and in the 'formit' leaving both ends overlength until I was happy with the fit. I decided to cut around where the draincocks fit rather than cut a hole and let the draincock hold the cladding in place in this area. The reason for that is due to the valve bodies not having a round mount to help seal the part and I decided it best to have a solid contact with the cylinder itself. RIGHT: 5. Here is the cladding, now held on with a few bolts. I then needed to trim the top to get a good fit close to the running board. This picture shows the result.



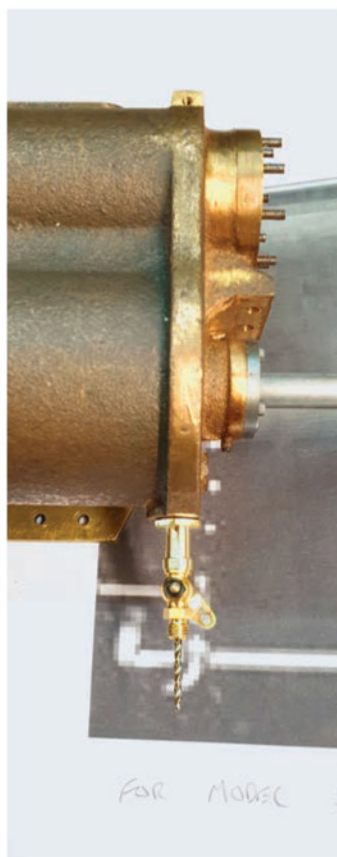
6. Before painting the cylinders I first fitted each cylinder along with the main running boards and the top running boards to mark out the access area for the main steam-pipes. The cylinders were then painted in the same 'Eastwoods' radiator satin black as used for the middle cylinder.



7. Now that I had some idea of what was going on I made a start on the relief valve body. I chose to use $\frac{3}{16}$ inch brass hex bar as the basis for the body and the first job was to turn a small spigot for the thread required to fit the cylinder. The picture shows the first body, having had the spigot turned and threaded and also that it's had a $\frac{1}{16}$ th hole drilled through it, which matches the hole size in the draincocks. I decided to use commercial draincocks and the ones that I have chosen are from Polly Engineering, as these are more or less the same as those fitted to the prototype.



LEFT: 8. Here we can see a relief valve body blank temporarily connected to one of the $\frac{3}{16}$ x 40 draincocks. I then began machining the blank down to something that looked like the profile I could see on the 1924 photograph of 4472 (then 1472). RIGHT: 9. Here is what the profiled drain cock looked like on a cylinder.



bars need to be fitted to the frames. Therefore, this instalment will cover the work involved to get the cylinders ready for fitting and it was at this stage that I realised that the draincocks also need to be made and fitted along with their linkage.

Draincocks

I then paid attention to the draincocks and here I learnt something - many thanks to those who helped me here. I wasn't aware that there relief valves fitted to the draincocks. Interestingly, these were kept even when, around the mid 30's, the cylinder cover relief valves were fitted. So, for all of 4472's career she had draincock relief valves and from the mid 30's she had both types of relief valves, well into preservation days.

Relief valves

Now I needed to decide after close scrutiny on the final look/design of the relief valves and permanently fit them to the draincocks.

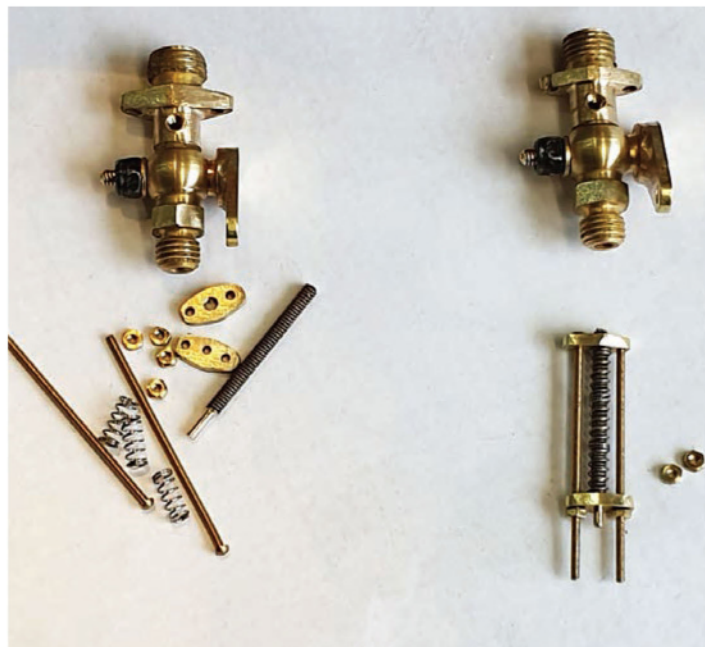


LEFT: 10. Before profiling the relief valve plate blanks, I decided to complete the body first so that I could work out where best to sit the plates on the body. The first thing to do was to drill the mounting holes into the body flanges. Here we see one of the bodies being drilled on the rotary table at 180 degree spacing. These were drilled 1.4 mm to be threaded later 10BA for dummy studs/nuts to be fitted once everything else has been completed. I chose to use hex bar instead of round as it gave me something to hold better for the various setups involved. RIGHT: 11. With the holes drilled across the 'points' it was easy to mark out the flange and first cut using a cutting disc and then file to shape. I did it this way rather than on the mill as I had full control of the part which may have come loose using a cutter, that is the rotation of the cutter would undo the thread.

LEFT: 12. With the body now ready to be silver soldered to the draincock I removed the draincock tap and worked out the orientation for each cylinder. Not only do I have to allow for opposites as usual but also work out front and back for the thread to fully tighten into the cylinder and also work out the front for the relief valve apparatus. With this all noted each assembly was held in a small vice, and a suitable piece of piano wire was used to align the bodies. To ensure the wire wouldn't end up also being soldered to the assembly it was first pushed through some bar soap to stop this from happening. RIGHT: 13. Returning to the mill and still using the hex to hold the part I drilled a 1.4 mm hole into the body for the valve itself to fit, more on this shortly.



14. Turning to the relief valve plates, I assembled them in groups of four using 14BA screws and filed to shape as can be seen done to one group here. I'll explain the assembly a little, while on this picture. There are three rods (for want of a better word) between two plates. The central rod is the valve with a spring over it and this is the valve itself. The two outside rods have a threaded section on each end and this is how the pressure is adjusted by screwing in the front plate to compress the spring of the valve. The next job was to machine a small 1 mm wide spigot on the end of each length of 10 BA studding.



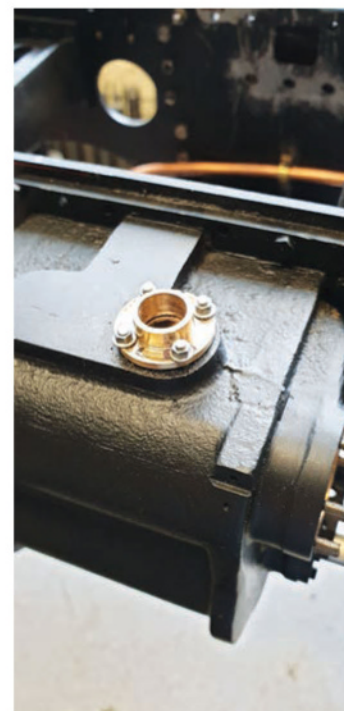
15. Here I have laid out the various parts involved and also part assembled one of the relief valves to give a clearer look at what is what. The springs are 0.25 mm wire and 5 mm long by 2.2 mm outside diameter - these are a nice fit and once assembled onto the valve they look like one long spring. These parts are very small and a little fiddly to assemble but I have worked out a procedure now and once the cylinders are ready I'll fit them in place. The threaded section of the valve will be secured to the body using Loctite. I was wondering how well this will seal but then thought, why worry - if it leaks it will just look like working relief valves but I'm pretty sure that the Loctite will do the job.



16. I thought that I'd try one assembly in place to see how it looks. In this close-up I can see that I have a little more profiling to do on the plates. I haven't fitted the dummy 10 BA studs/nuts to hold the body to the cylinder yet and also the 14BA screws will need their second locknut fitted and then finally cut to length.



LEFT: 17. This picture shows the first flange being parted off. RIGHT: 18. I added an 'O' ring rather than rely on a plain gasket and here I have machined the groove for the 'O' ring.



LEFT: 19. To make life easier when mounting the flanges to the cylinders I used a small amount of the high temp silicone used for sealing the exhaust outlets to hold the 'O' rings in place. RIGHT: 20. Here's one of the flanges bolted in place.

Steam pipe flanges

Then I moved onto the steam-pipe flanges. Don has these as plain discs but I have added a spigot for the copper pipes to fit into. I see this as both being easier to silver solder together and also a stronger joint. I have made mine from bronze.

Draincock linkages

Next, I moved back to getting on with the draincock linkage. I first made the shaft, silver soldering its arm in the middle and making the end arms to connect to the outside draincock linkage. The arms need to be bent to meet the

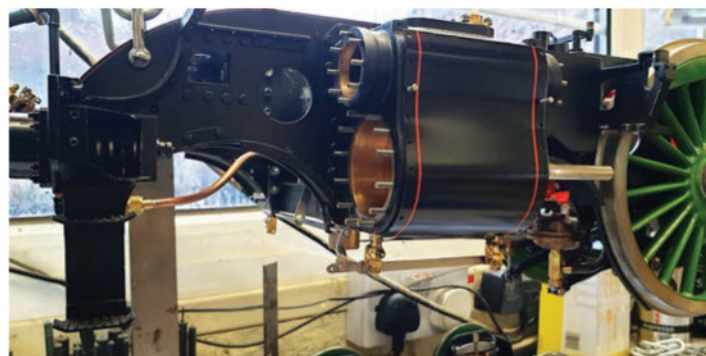
draincock links and shaped to look something like the close-up photographs of the prototype. I fitted the cross shaft temporarily so that I could fabricate the end arms so they lined up with the draincocks. Photographs of the full size show me that the

arm has a dogleg and that the pivot point for the link is below the draincock arm hole.

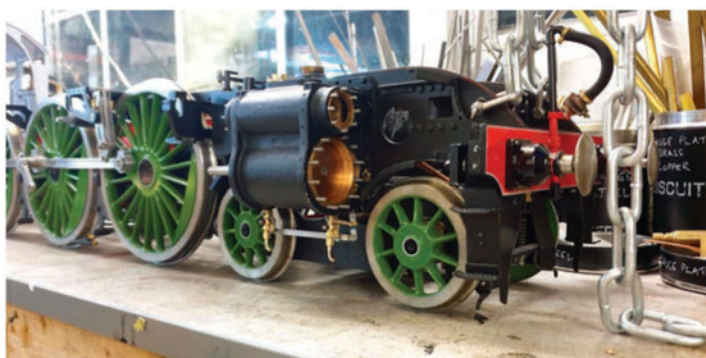
●To be continued.



21. Here the cross shaft is temporarily fitted for me to fabricate the end arms so that they line up.



22. Here we are with the various parts assembled ready to test. As can be seen I have also found time to paint the cylinder cladding and line it with vermilion red. I've left the relief valves off for now. The link across the draincocks to the control arm needs the end hole cut off and profiled - I was playing with various setups until happy with how the linkage/Bowden cable worked.



23. I have now fabricated the right-hand draincock linkage and made the drop pipes. I'll shorten these a little later to be closer to the prototype. The nuts are a little large which adds to the oversized look so I'll also shorten these. I'm pleased with how they look compared to full size. You'll note that I have only placed one relief valve roughly in position for effect. I'll leave these off until final assembly as they can't be fitted until the cladding is in place.

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■ Drummond M incomplete. Please phone for details. **T. 01423 322293. Boroughbridge, York.**

■ Myford Super 7 No SKL5935 34 inch bed on makers stand single phase 3 and 4 jaw chuck some gears damaged belt cover otherwise OK £750.00 collection from Ramsgate. **T. 01843 594223. Kent.**

■ Cutters, attachments for lathes, vertical, horizontal milling machine, floor standing back geared pillar drill outside, inside depth micrometers height vernia 24" midsaw vertical engineers 2 speed bandsaw depth 16", width 20" compound table 3hp motor, all above rock bottom prices. **T. 01142 334758. Sheffield.**

■ Atlas 10" Model D or F Lathe. I inherited it from my father many years ago. See 'Scribe a Line' for details. Offers welcome. **T. 07770 276 168.**

■ Jasig Tig 200P Inverter Tig Welder 200 amp complete kit torch tungstens,

cylinder flow meter, also does MMA stick welding, £400. **T. 07974 071187. Manchester.**

■ Dean Smith and Grace lineshaft driven lathe, 18" swing, 32" gap, 6' very good condition, 92mm bore, this Rolls Royce of lathes was new to Levant Mine in 1920 mining work from then to today, 3 tons interest? **T. 01803 557107. Torquay.**

Models

Parts and Materials

■ Plans and Engine Castings for Vintage Ostler Mini-auto for motorising Bicycle. Please phone for details. **T. 01423 322293. Boroughbridge, York.**

■ Building a Showmans engine in 6inch scale? Want a generator for the front? This may suit: Crompton Parkinson 200V 4.6A 1425rpm shunt 72kg 6inch shaft height, 1inch shaft dia. Free to genuine builder. Collection only. **T. 01373 812792. Bath.**

■ Britannia 4-6-2 3½" starter kit, boiler copper kit, two frames, wheels, axels,

horns complete, tender frames wheels, cylinder set GM pistons drawings, £500 ono. **T. 01706 825157. Bury.**

■ For Boxhill 5" Gauge Loco - Drawings, 8 Sheets. Laser Cut Frames & Buffer Beams. Wheels. Eccentric Straps. Hornblocks. Axleboxes. Motion Plate & Bushes. ME Magazines covering the construction series. All as new (Reeves), un-started project. £300. **T. 07740 184522. Bognor.**

Magazines, Books and Plans

■ Model Engineer numbers 4472 -4627 (2014 -2019), free to good home. New owner collects from Gateshead area or arranges to pay for shipment. **T. 0191 4140500. Gateshead.**

Wanted

■ Motor for Toyo/Record/Manix ML210. Or complete lathe in working order. Cannot source a new one from Proxxon. **T. 01303 250504. Folkestone, Kent.**

■ Wanted a copy of the book 'Making the most of the Unimat' by Reg Tingey, must be in good condition. **T. 07759 578688. Manchester.**

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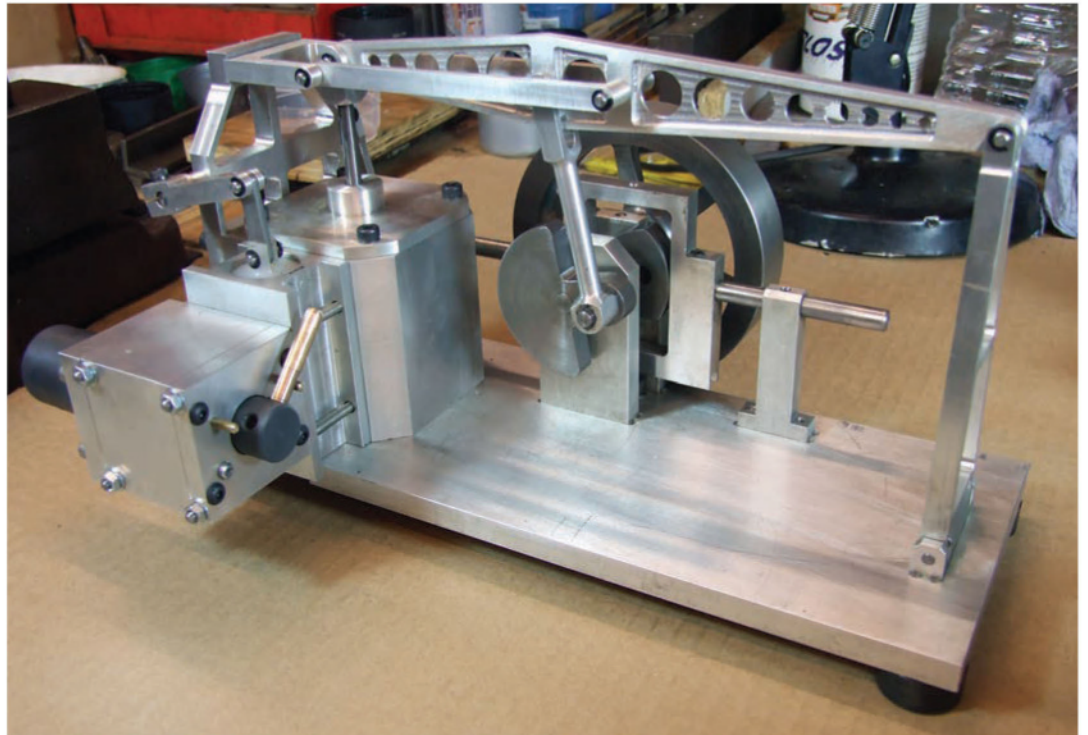
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Continued from p.28
M.E. 4706, 16 December 2022



PART 10

Grasshopper Beam Engine

Item 18 – Piston Rod (fig 29)

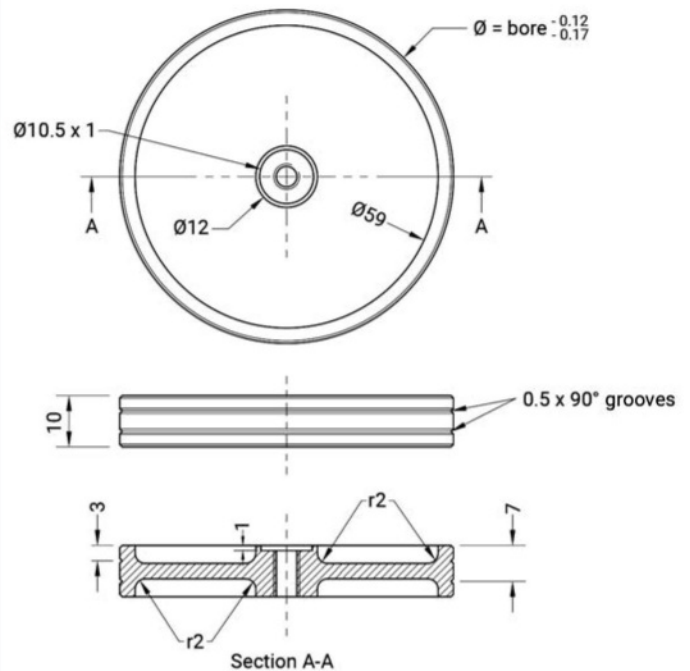
6mm diameter silver steel

* Face silver steel at each end bringing to 99.5 length.

* Machine $\varnothing 5 \times 7$. Thread M5. Chamfer end of thread 45 degrees $\times 1$. Undercut 1×0.5 to remove thread 'runout'.

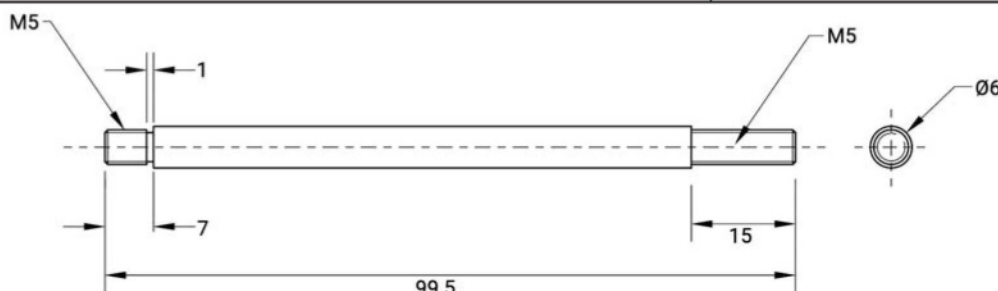
* Turn around, machine $\varnothing 5 \times 15$. Thread M5. Chamfer end of thread 45 degrees $\times 1$. Put to one side.

All dimensions are in mm
Tolerance for all parts in the article - unless otherwise stated:
Non-functional (i.e parts that do not fit all match) $\pm 0.1\text{mm}$
Functional (i.e parts having to match) $\pm 0.02\text{mm}$



Item 19. Piston
Chamfer all edges $0.5 \times 45^\circ$

Fig 30



Item 18. Piston Rod
Mat'l: Silver steel
Chamfer all edges $0.5 \times 45^\circ$

Fig 29

Item 19 – Piston (fig 30)

70mm diameter $\times 1$ inch acetal
* Prepare blank to $\varnothing 68 \times 10$.

* In the same manner that the recess in the flywheel was machined, use a tool having a 2 radius on each side making a $\varnothing 4$ semicircle to machine a 3.5 deep recess between an inner diameter of 12 and outer of 59.

-

- * 3mm from each edge machine two 90 degree x 0.5mm deep grooves.
- * Chamfer each edge 45 degrees x 0.5 (**photo 55**).

16 x 16 6082 aluminium
Work on this part starts on the lathe.

This part can be dealt with very easily if you have a four-jaw self-centring chuck. Otherwise, mark the centre as accurately as you can

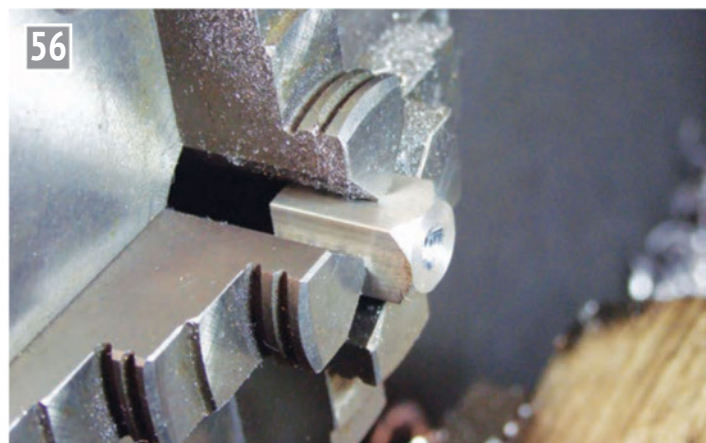
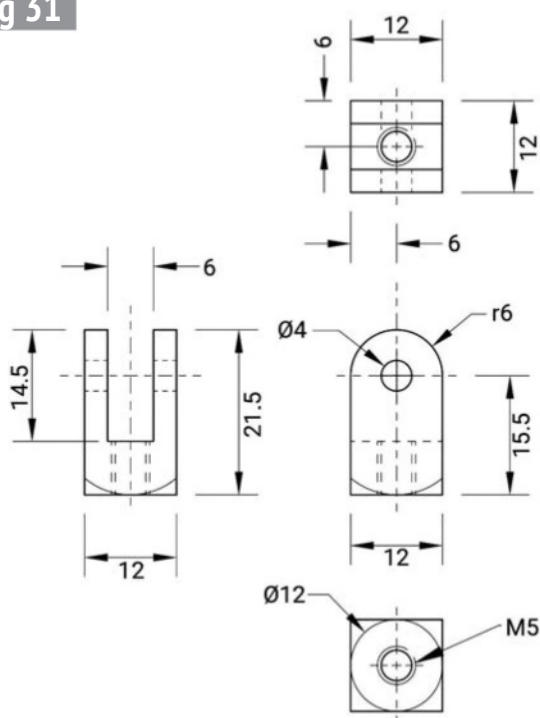
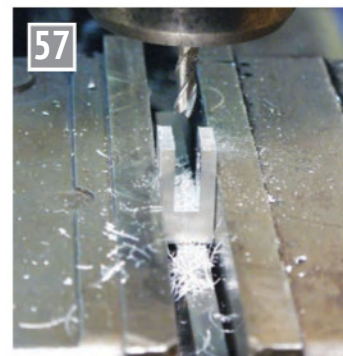


Fig 31



and centre punch one end before setting up in a four-jaw independent chuck, using the 'wobbly centre' method.

- * Face off. Centre drill, drill $\varnothing 4.2$ and tap M5 x 10 deep.
- * Chamfer end 45 degrees to produce $\varnothing 12$ (**photo 56**).
- * Turn around. Face off to 21.
- * Transfer the work to the mill
- * Clamp holding the blank on its side using suitable parallels to bring near to the top of the jaws.
- * Zero the spindle between the vice jaws and 15.5 from the chamfered end.
- * Centre drill, drill $\varnothing 3.8$ and ream $\varnothing 4$.
- * Reposition with chamfered end on a suitable parallel to bring the blank just above the top of the jaws.
- * Using a $\varnothing 5$ end mill, machine a slot in 2mm stages to 14.5 deep. Then feeding slowly, take 0.5 from each side to produce the required 6mm

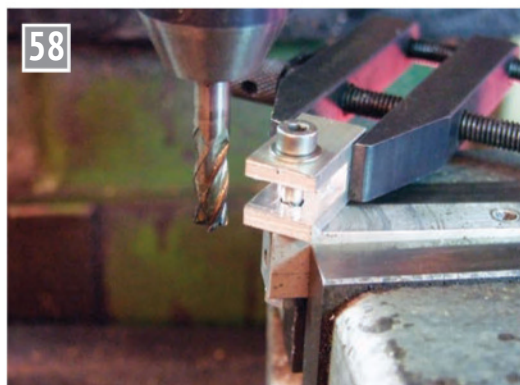


Slotting the clevis.

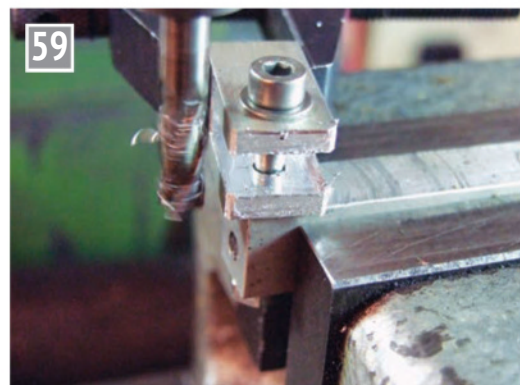
wide slot. Check width with a $\varnothing 6$ cutter shank (**photo 57**).
* Finally machine the end 6 radius in small steps using the reamed hole as a pivot point.

Provided the term 'climb milling' is understood and care is taken to avoid creating such a situation occurring, the next step can be done with machine assistance accurately/ uniformly by the manufacture of a simple fixture:

- * Drill and tap an M4 threaded hole in the centre and 5 in from the end of a piece of material around 12mm square (or larger) by at least 30 long for use as the fixture.
- * Select a bolt (ideally having a portion of its length plain) long enough to go through the fixture and the item to be radiused (in this case the clevis blank), plus at least 6mm.
- * Onto this is placed a plain washer before passing through the clevis blank. The bolt is then threaded into the fixture and tightened just sufficiently to remove any play – but not so tight as to distort the clevis sides, and then a lock nut fitted and tightened, securing the bolt to the fixture.
- * Clamp the assembled fixture into the vice positioned to the right of the spindle and raised on a suitable parallel to protrude 2 – 3mm above the vice jaws, before tightening a toolmaker's clamp onto at least 7mm of the clevis at the chamfered end. Confirm that the clamp is gripping securely.
- * Set an end mill of around Ø6 to the centre of the vice jaws with the end just clear of the lower face of the assembled clevis and to left hand side and clear of the clevis, with the clevis rotated to the rear of the vice (**photo 58**).
- * Start the spindle and slowly carefully rotate the work by holding onto the clamp, 180 degrees from the REAR to the front and back slowly to the rear of the fixture. ONLY



Forming the rounded end of the clevis.



The starting position for the rounding operation.

advance towards the cutter in SMALL INCREMENTS when the work is held at the REAR POSITION using the X axis towards the cutter, until the extreme corners of the blank contact the rotating cutter. **Photograph 59** shows the start position. REMEMBER this is the ONLY POSITION that feed may be applied.

- * Continue feeding between 0.1 – 0.15mm when at the rear position after each 180 degrees 'swing'. You will see the radius form at the end of the clevis (**photo 60**).
- * Continue the process of feeding the cutter towards the pivot bolt, stopping when you see that a continuous full semi-circle is about to be formed. Take care not to go too far otherwise you will leave two 3mm radii in the flat face of the clevis sides. Rather stop short and give the final 'blending' of the radius into the flat side with a smooth flat file/abrasive paper.

The foregoing instructions will most likely suit right



The end result of the rounding operation.

handed constructors, as the position of the clamp lends itself to being held by the right hand. For the left handed the instructions are basically the same except that the fixture initially needs to be positioned to the right of the cutter. **Photographs 61** and **62** show the respective start and finish positions of the final cut, prior to clean-up, for any constructor who may prefer to control the process with their left hand.

●To be continued.

ERRATA

A couple of inconsistencies have crept in, unfortunately. Firstly, there is some confusion in parts 4 and 5 about the diameter of the cam follower shafts. Figure 10 in part 4 shows the diameter of the cam follower shaft to be 6mm whereas the text states correctly that it is 8mm. In part 5 figures 14 and 15 incorrectly show the shaft diameter as 6mm. The text and figure 16 though have it correctly at 8mm, as does the parts list.

Secondly, the material for the crank web, featured in part 6, is stated as being aluminium whereas in the parts list it is listed as EN1A, although aluminium, I'm sure, would be quite satisfactory.

My apologies for these discrepancies and any inconvenience they may cause – Ed.



Starting position for left-handers.



Finishing position for left-handers.



The train.

Gerald Martyn shares his experiences of building 5 inch gauge wagons for the LSWR.



Building some LSWR Wagons PART 2

Continued from p.749
M.E. 4705, 2 December 2022

Now to the actual job. **Figure 1** is the general arrangement for my interpretation of a 5-plank open goods wagon as built by or for the LSWR in the late nineteenth century. It is based on photographs, an original drawing of a wagon of a slightly different type and those small drawings published for O-gauge modellers and others working at small scale. It is therefore representative of the type and not an exact scale model. As mentioned above, the dimensions had become standardised by this time so the drawing could be re-interpreted for just about any railway. To create the timber parts, then, not much more than this drawing is needed but I'll introduce an underside view next time.

Laser cutting by Model Engineers Laser ([ref 1](http://modelengineerslaser.co.uk)) was used for some metal parts and proved to be an economic time-saver. Cut the 'W-Irons' by hand if you wish, but laser cutting allows easy 'nesting' of parts and will save metal as well as a lot of effort. As there are so many detail differences between wagons built to the same outline specifications

I've not provided too many detail drawings, just do your own thing. Model Engineers Laser have refreshed versions of the models for just the W-Irons and my version of the coupling hooks and I'll give details for these when I get to the right place in the story. Even these will differ between railway companies, but perhaps not enough to be a problem for other than an 'expert'. Just remember, there were hundreds of thousands of wagons with so many differences that if you stand your ground it would be almost impossible for the 'expert' to prove you wrong. As an aside, I've never met such an expert but I did overhear a conversation about one of my models at a Model Engineer exhibition many years ago, saying the brakes were on the wrong side of the wheels; he was wrong, of course. The rest of the metal parts can be made easily at home or you could produce your own drawings for laser cutting. In some cases, Plasticard will make a good substitute - it is easier to work than metal and, when painted, will be just as good. Wheels are now cheaper to buy as a

complete ready-to-run set than as iron castings and bar for home machining, so along with the saving in work it's financially sensible to do so. The purchased ones may have plastic hubs and spokes, but they're plenty strong enough. There is also, now, at least one supplier of a range of wagon parts advertising in our magazines, as well as complete kits, so giving an alternative to doing a lot of the work yourself. However, this comes at a price. Doing my own thing is satisfying and keeps me occupied indoors on winter days, but it's also ever so much less expensive than building a kit or buying the finished product. And at the end of the process I can also stand proud and say 'yes, I made it' whilst spending the money saved on something else.

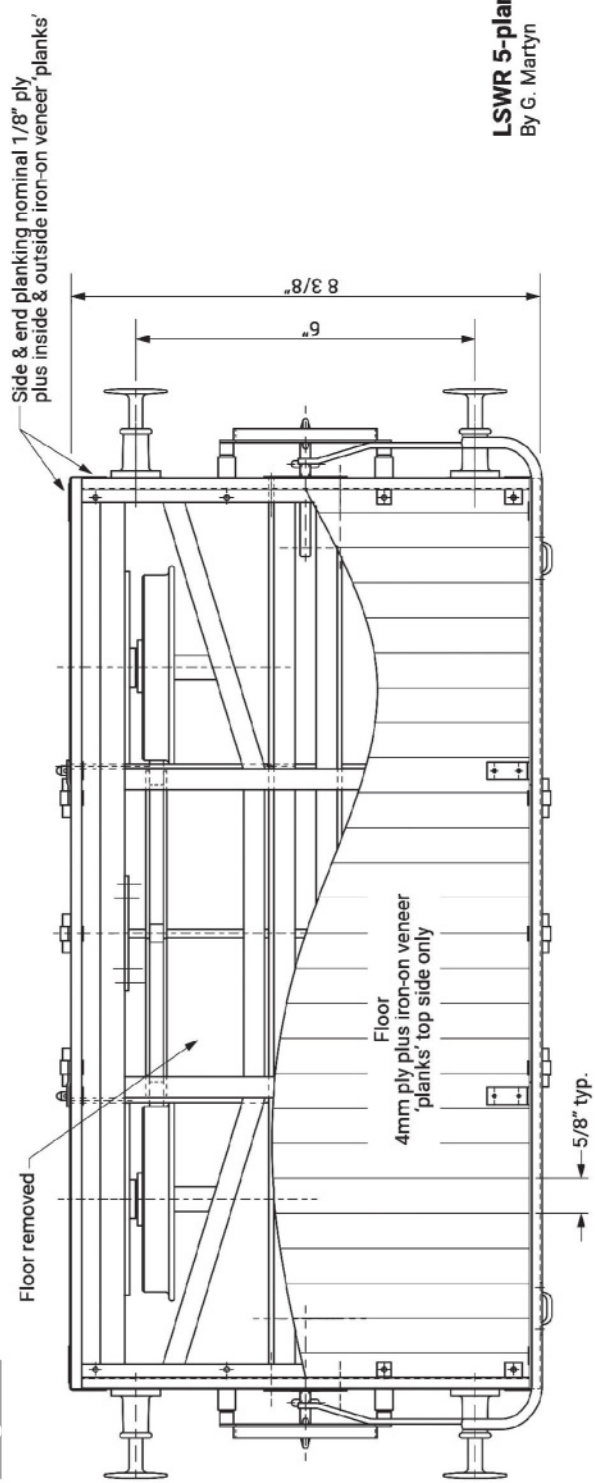
●To be continued.

REFERENCE

1. modelengineerslaser.co.uk

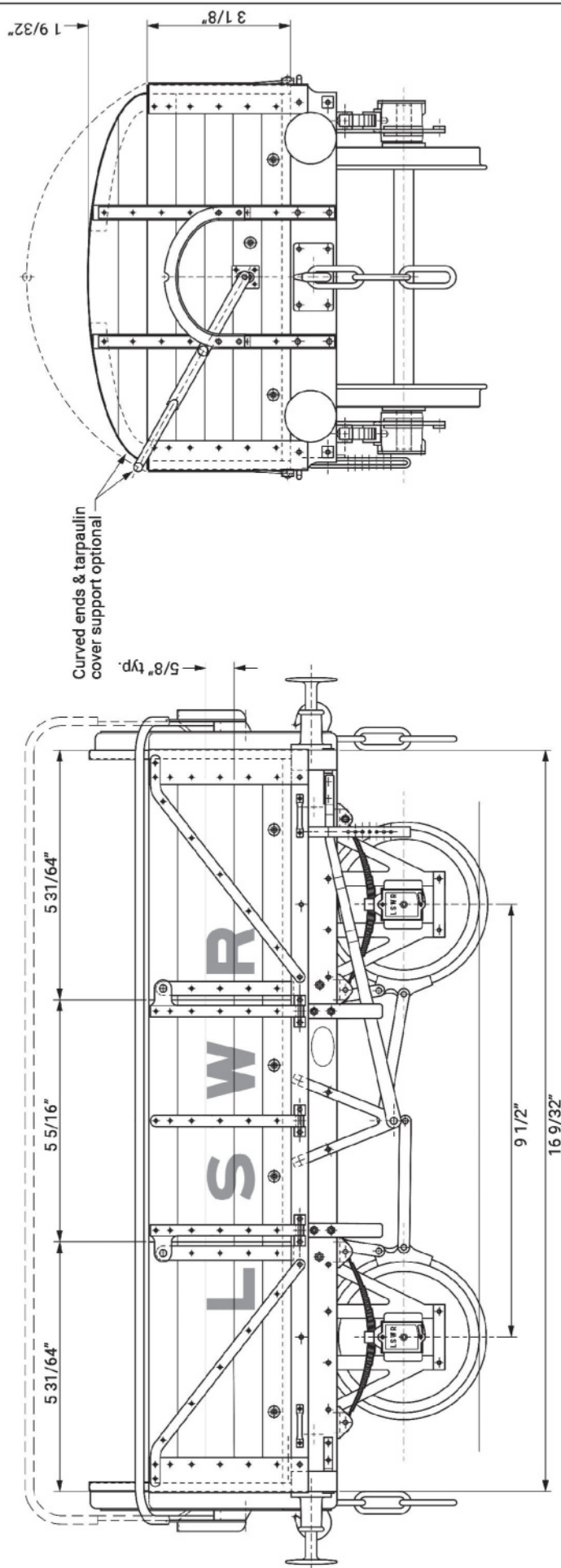
Fig 01

General arrangement.



LSWR 5-plank Wagon For 5" Gauge

By G. Martyn



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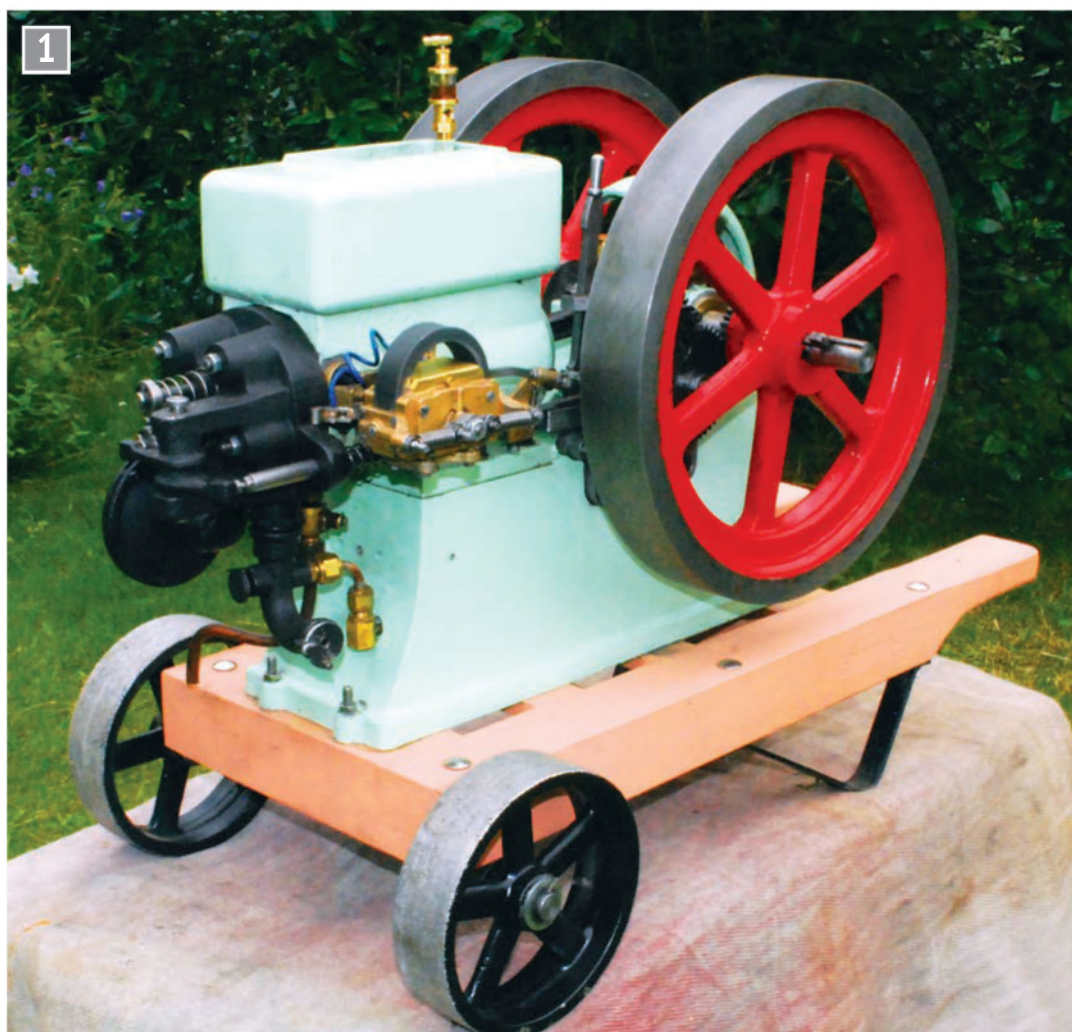
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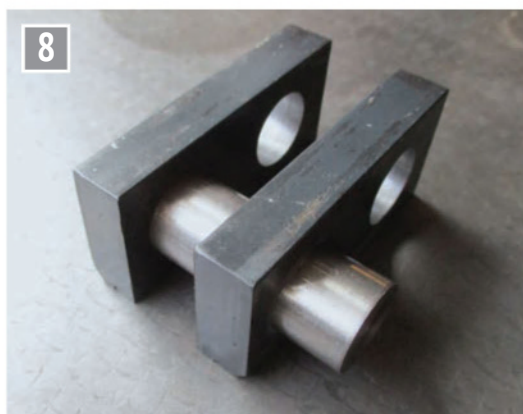


Continued from p.45
M.E. 4706, 16 December 2022

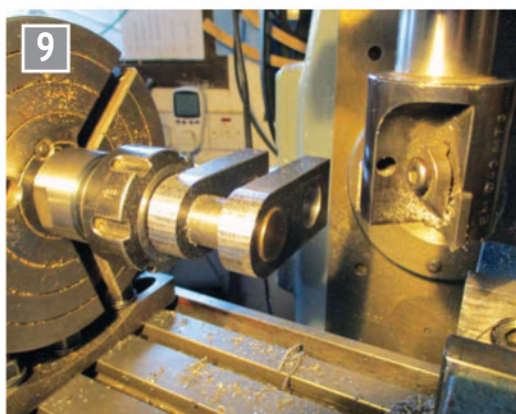


The completed 'hit and miss' engine.

'Hit and Miss' Internal Combustion Engine PART 2



Crank pin and webs heat shrunk together.

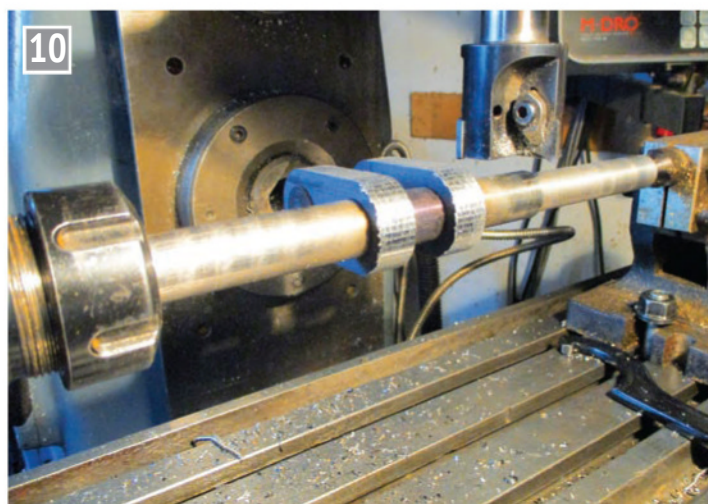


Flats machined on the webs to form the curved end.

Crankshaft

This started out so well...

First the webs were made and the crank pin heat shrunk in place (**photo 8**). Holding the end of the pin, a series of flats were machined (**photo 9**) which would later be finished by hand. So far, so good. Now it starts going wrong. The crankshaft was machined then heat shrunk into the webs. I didn't allow for the contraction of the steel though, which pulled the shaft out of true. I did manage



Ends formed on the other end of the webs.

to straighten it on the press, then machined the other end of the webs (**photo 10**).

For security, I drilled and pinned the shaft to the webs. It didn't help. I'll jump forward a bit here. When the engine was built and tested, it ran for a short period, the slowed and stopped. Drat! Investigating the problem, I found that the pins had sheared and the shaft had rotated in the web, shifting the timing. Double drat! I realised that I'd have to start again, but then thought, well, the shaft is scrap, so I've got nothing to lose - let's try welding it.

Using the trusty Dremel, I ground out the best 'V' I could around the ends of the shafts between the webs (no photos, I wasn't in the mood...) then set about welding. I couldn't get a MIG welder in between the webs, I haven't got TIG and I didn't fancy trying gas, so it had to be stick. This needs a steadier hand than mine but I got a weld in place in the end.

I fully expected distortion from the welding to leave me with a good imitation of a banana, but it only had about 4 thou runout, most of which was removed on the press. So far, it's all held together, but it does appear that there's a lot of shock force on the shaft from the force of the piston and the inertia of two heavy flywheels. Next time, I'd make it from solid.

Cylinder

This is basically the aluminium combined cylinder and water



Boring the cylinder casting.

hopper, with a cast iron sleeve. First, the mounting face was machined, the mounting holes drilled and one side skimmed to provide a true reference surface (**photo 11**). The DTI is there to make sure nothing moved, just in case!

Next, the casting was mounted vertically to bore the first end of the sleeve hole, using the reference surface to ensure it was true to the mounting holes (**photo 12**). It was then turned around and the other end bored to take the stepped end of the sleeve. The hole for the water drain cock was drilled and tapped on the underside while the sleeve was out. (I added a small flat to the sleeve directly above this hole to give a little more clearance for water flow. It would have been a bit tight without this.)

On to the sleeve. There was a big lump of iron to remove from the centre! I started with the



Preparing to skim the casting to get a reference surface.



Boring the cylinder sleeve.

biggest drill I had, then bored from there to a little under finished size. Then the outside was roughed to a little oversize. After ensuring that the sleeve was still tight in the chuck, the bore was bored to about half a thou under size, to allow for honing (**photo 13**). Note the strip of lead wrapped around the end to reduce ringing and chatter. Then the outside diameter was machined to about 2 thou oversize, the idea being to heat shrink the sleeve in place. Again, the lead strip was used to reduce chatter.

Now the exciting bit, fitting the sleeve. First the press was set up ready to press the sleeve in place, just in case... The cylinder casting went into the oven and the sleeve into the freezer. After a suitable time, the bits were retrieved and the sleeve applied to the casting. What an anti-climax. It dropped straight in. Then

the assembly was returned to the mill to face the end for the head and drill and tap the holes for the head studs.

Now it's decision time. I have to choose an ignition method. Here's the choices, in order of preference:

1. A working, half size, Webster Tri-polar Oscillator with igniter. Not much chance of that.
2. An igniter working with a battery and coil. This would be true to prototype, as early engines used this method.
3. A dummy Webster and igniter, with a concealed spark plug operated by electronic ignition.
4. Admit defeat and use a spark plug and electronic ignition.

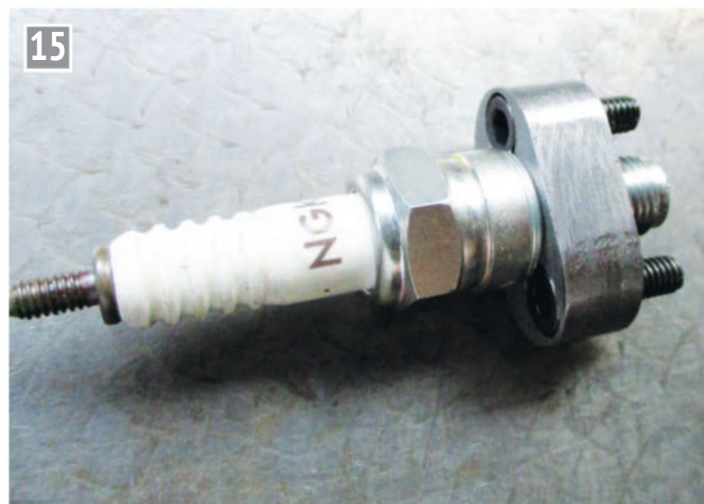
As I like a challenge, I chose option 4... However, I wanted to leave all options open. For

a spark plug I'd need a M10 x 1 tapped hole, while an igniter would need an elongated hole. First step, draw up an igniter. Here's the result (**photo 14**), with the moving contact at the top and the insulated contact at the bottom, with two mounting holes. That establishes the size of the hole and the mounting. But what about a spark plug? The answer is an adaptor as in **photo 15**. The igniter is narrower than the plug so some clearance was needed.

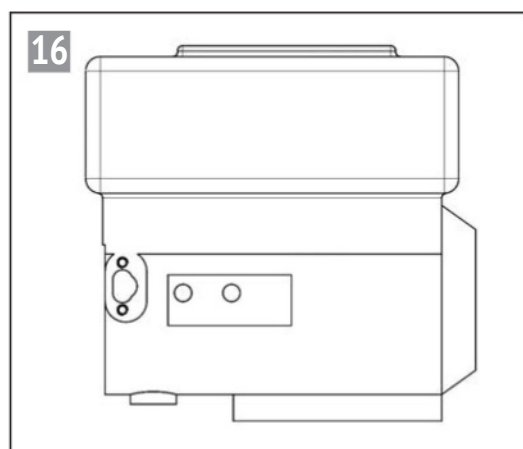
Photograph 16 (okay, I know it's not a photo!) shows the final hole. The clearance for the plug is offset, as the hole is close to the end of the cylinder and I didn't want to lose any more material. Later, I found that a short reach plug, which didn't extend beyond the adapter, worked perfectly, even though the points were in quite a deep pocket, so the clearance in the cylinder hole could have been left out. **Photograph 17** shows the cylinder, with head face machined, studs fitted and the mounting face for the adapter or igniter being machined.



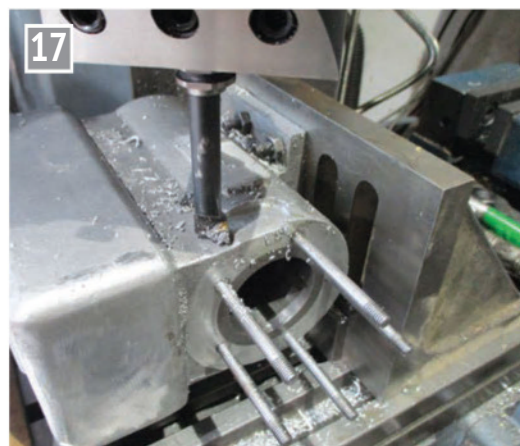
Design for the igniter.



Spark plug with adapter.



The position of the hole for the igniter.



Milling the mounting face for the igniter.

●To be continued.

NEXT ISSUE

Waterwheel Clock

Eric Rumbo makes the ball cage and driving electronics for his version of a skeleton clock.

We Visit Bristol SMEE

John Arrowsmith spends a pleasant day at the Ashton Park track of the Bristol Society of Model and Experimental Engineers.

Grasshopper

Martin Gearing makes the link anchor mount whose main purpose is to support one end of the beam of his grasshopper engine.

Hit and Miss Engine

Ian Couchman casts the piston and connecting rod for his 'hit and miss' internal combustion engine.

Oscillator

Hotspur makes a start with adding the fittings to the vertical boiler for his triple cylinder oscillating engine.



Content may be subject to change.

ON SALE 13 JANUARY 2023

LNER A4 PART 1

Development - *Mallard*

Robert Hobbs restores a rather battered A3 as an A4.



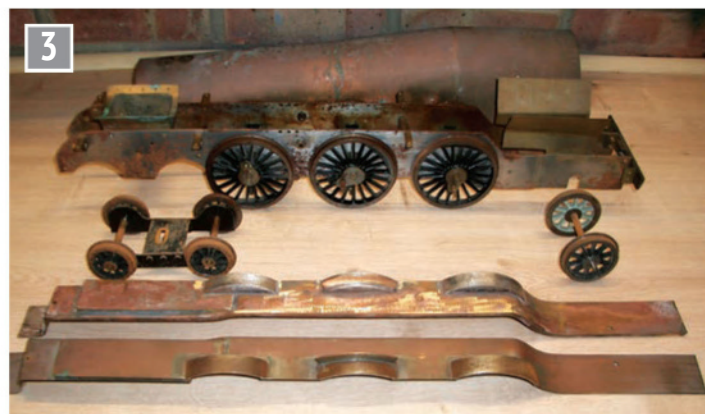
The author's 2½ inch gauge A4 Mallard.

Mallard, an LNER A4, streamliner shown in **photo 1**, is my latest locomotive project and it is worth remembering that some projects do not come to fruition for many years. This project has its roots in a visit to the National Railway Museum at York some 40 years ago and **photo 2** shows Fiona, our daughter, standing in front of Sir Nigel Gresley's A4 locomotive, *Mallard*. The search, through our old albums, for this photo was prompted by a call from Fiona saying she was standing in

front of *Mallard* once again. Well how could one resist, especially as I was looking for a new project after finishing my LNER V2? Should the project start from scratch ... and in what gauge? The gauge question was easily answered as the last Pacific in 3½ inch gauge so dominated the study that future 4-6-2 Pacifics would have to be 2.5 inch. The success of the build would depend on my ability to create the iconic streamline casing, so to limit my expenditure on a project that could end up under the bench, the search

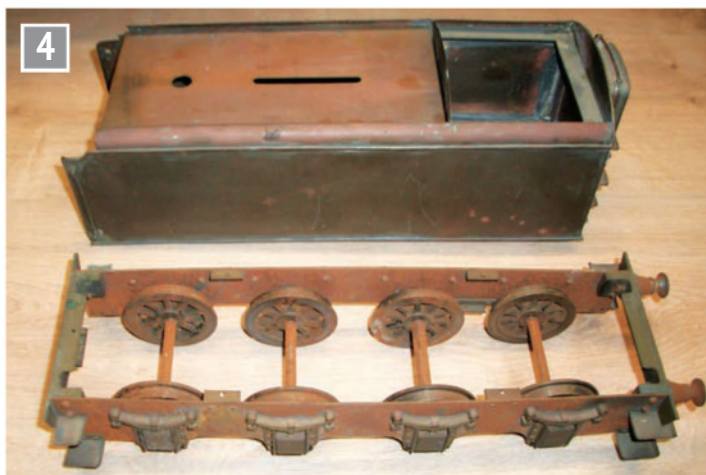
was on for a 2½ inch A1/A3 *Flying Scotsman* part finished project on the dreaded eBay. Adopting this approach gave me two options, the prime one being an A4 and the fall back one an A3.

The eBay searches soon produced a discarded Bassett Lowke A3 and when it arrived it was surprisingly complete, although totally corroded and rusted solid. **Photograph 3** shows the locomotive chassis and boiler casing after dusting and a quick wipe over with a rag while **photo 4** shows the tender components as



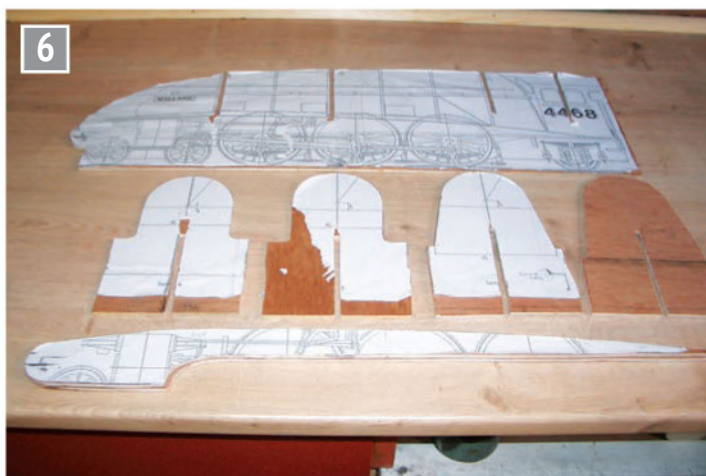
The donor A3 chassis.

Inspiration.



An example of plank on frame construction.

The tender, as received.



Building jig for the casing.

Formers for constructing Mallard's casing.

received. The Pacific had the name *Sansovino* on the splashers, relating to its LNER number 2552 and British Railways Number 60053. *Sansovino* was built in 1924, rebuilt in 1943 and scrapped in 1963 and was the name of the 1924 Derby winner; the LNER adopted Derby winner names for many of their Pacific locomotives.

This was my first contact with a Bassett Lowke design and I was pleasantly surprised at the detail and quality of the castings and fittings, especially for such an old piece of kit. Checking references for BL and looking through Tee Publishing's catalogue, *Construction of a Bassett Lowke 2½ inch gauge 4-6-2 Flying Scotsman* published in *Practical Mechanics*, was found and quickly ordered. This facsimile booklet provided drawings and construction details with some useful 'words and music'. Now the crux of the whole project, the streamline casing, was the

object of my attention and I was pleased to discover that the Locomotive Design Co. offered a set of drawings that would provide the construction details to manufacture the A4 streamlining and thus, hopefully, convert an LNER A3 into an A4 Streak. The drawings in the booklet were copied and expanded to the same scale as the drawings of the Locomotive Design Co. enabling the spacing to be checked and the A4 casing outline to be superimposed on the 'Scotsman'. Overall the only discrepancy was the position of the front bogie, which was not a significant problem, and new mountings were required for the casing as the running board fixtures would not suit the curved side skirts of the A4, so the project was started in earnest.

Drawing inspiration from my other hobby, model yachting, where in the past some of my yacht hulls have been constructed as plank on frame, this looked to be the

best solution for building up the shape of the A4 casing. **Photograph 5** shows one of my yacht hulls being planked with the internal removable frames being clearly visible. The side profile of the A4 was cut from multi-ply sheet, as were several stations defining the cross-section profile; these were assembled similarly to the yacht hull but the other way up. The cut-out sections are shown in **photo 6** and the completed building jig

in **photo 7**. To determine the outline of the steel sections of the casing, a wooden skin was made to fit the jig, thus enabling accurate paper patterns of the two main sections to be cut, that would give the shape for cutting the sheet steel. This mock-up is shown in **photo 8**.

The sections were cut out using the Vibro saw as shown in **photos 9** and **10**. These were then rolled to shape using the 12 inch slip rolls.



Mock-up made before cutting steel.

This was a lot easier said than done; the first section was ruined because the back roller of the rolls put too much curvature on the leading side relative to the following one. The second attempt was to roll half the casing from one side and then turn it around in the rolls and shape the other side. This method gave a neater shape but took a lot of little adjustments in the forming roll to achieve the correct shape. **Photograph 11** shows the front section of the casing in the rolls and **photo 12** shows the front door section being rolled. In **photo 13** the two section front door is shown together with the front of the casing. **Photograph 14** shows the first attempt at an assembly of the front end. (It's painted to hide the overall mess that was made of this area; it twisted, there were awful gaps and it was completely out of square.) A new set of casing sections was cut out and rolled to shape and it was decided to mig weld the sections on the jig. **Photograph 15** shows the casing before welding. Unfortunately, the welding was too heavy and the joints not tight enough and, if that is not enough discouragement, the side skirts buckled, the middle joint was not aligned correctly and the sides closed in, reducing the overall width making it unusable. **Photo 16** shows this distressed casing and I was left sitting with my head in my hands, wishing this project had never started. Taking inspiration from Robert the Bruce and his spider, the project had to be started again and, if necessary, again and again. This is an understandable point to leave this first section of my A4 project – with the hope that the second part will be more encouraging and result in a useful A4 casing ... or will the locomotive revert to an A3 named *Sansovino*?

●To be continued.



Ready to start cutting!



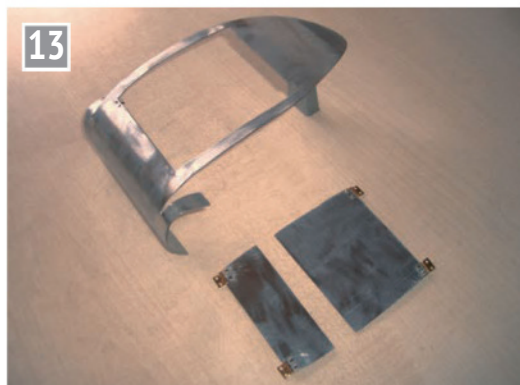
A couple of the sections.



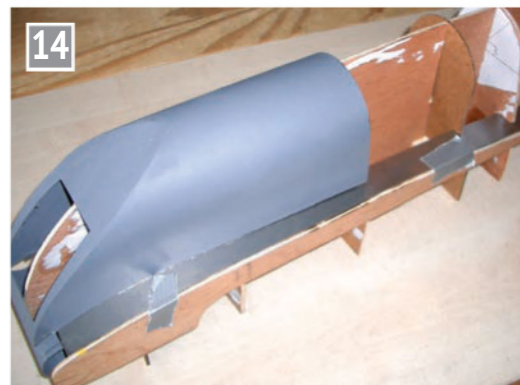
Rolling the front section of the casing.



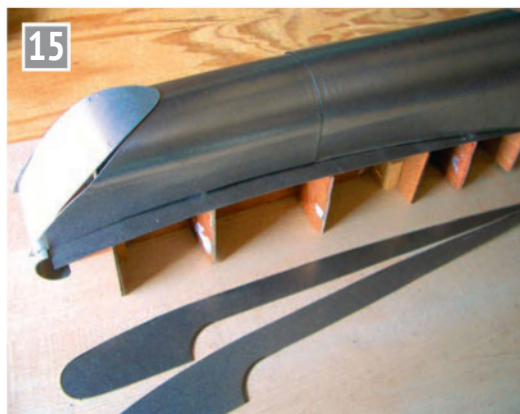
Rolling the front door section.



The front door starts to come together.



First attempt at the assembly of the casing.



Second attempt, before welding.



First attempt at welding.

The Eating of Elephants

PART 4 - OFF TO THE RACES

Steve Goodbody finds some things are best tackled in small helpings.



Continued from p.12
M.E. 4706, 16 December 2022

Having finished Bluebell and now seeking a new project, we left the twelve-year-old author who - together with his parents and Our Expert, an unnamed but much-appreciated steward at the Brighton Modelworld exhibition in 1981 - had decided that a six-wheeled tank engine called Rob Roy would fit the bill rather nicely.

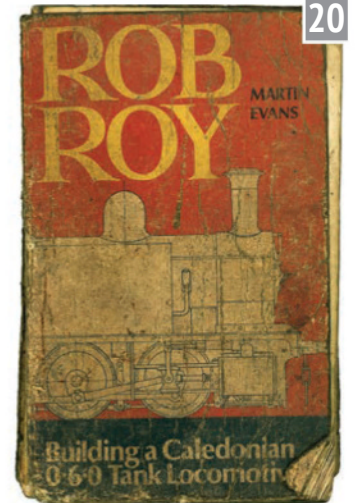
First hurdles, first stumbles

Over the course of the next few months, I read, re-read and re-re-read my coveted Rob Roy book with enormous enthusiasm (photo 20). I didn't understand all of it, if I was honest, but the pictures were great and I especially liked the penultimate chapter which explained how to drive the finished engine; I read that chapter a lot more than the rest. In my mind's eye I could see myself sitting proudly behind the simmering locomotive, nonchalantly popping a bit of coal on the fire, blowing the whistle, opening the regulator (as I discovered it was called) and

setting off down the track in a cloud of smoke and steam, all just as Mr. Evans described. And I wanted my Rob Roy to look just like Mr. Green's beautiful example which featured prominently in the book, of that I was already certain (photo 21).

I felt sure that the book would guide me, step by step, through the process of realising this vision and was also certain that it wouldn't take me more than nine months to build the engine, perhaps a year at most if I included painting. After all, if I could read the book in a few hours, cover-to-cover, then it should not take more than a year to build this engine. How could it?

As you, wise Reader, undoubtedly know, my timing estimate was naively optimistic. Further, as you will come to discover, that same mistake, the under-estimation of time, would become a sadly consistent habit of mine. But more of that later. Anyway, and with a spoiler-alert, the engine did get finished, but it was to take more than three years



Purchased new in 1981, the Rob Roy book bears the unmistakable scars of heavy use throughout the locomotive's construction.

before steam was raised for the first time (photo 22).

And so, with the pillar drill and the vice both attached to a sturdy bench in the garage and with my last year at primary school finally over and the long summer holiday in front of me, the time had come to make a start. Following the instructions in the book, having given the virgin mainframes a good coating of marking-out blue, I opened the first drawing. But consternation! While I could see the shape of the frames on the drawing and could identify the circles as holes, the scattered dimensions were completely meaningless to me! Where were the centimeters and millimeters with which I was familiar from school? Why was everything shown in inches? What were all these fractions about? And how did any of this relate to the incomprehensibly tiny markings on dad's steel Radio Spares ruler which I held in my hand?

Sitting down, I could feel the fear rising. Was I really going to fail at the first hurdle, not even capable of starting the



The inspirational picture of Mr. L. A. Green's fine engine (from: Rob Roy – Building a Caledonian 0-6-0 Tank Locomotive by Martin Evans M.I.G.T.E, 1979 edition, published by Argus Books Ltd. and reproduced with kind permission from TEE Publishing).

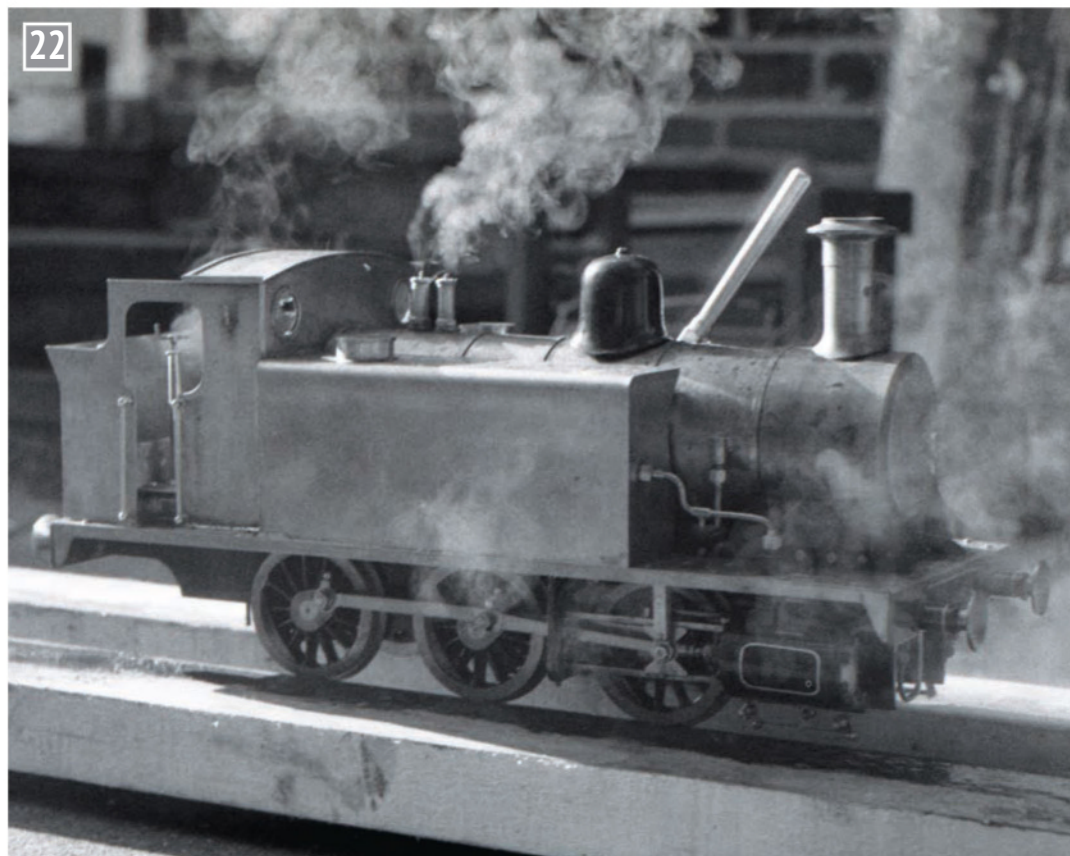
As you, wise Reader,
undoubtedly know,
my timing estimate
was naively optimistic.
Further, as you will come
to discover, that same
mistake, the under-
estimation of time, would
become a sadly consistent
habit of mine.

project which I so wanted to complete? It dawned on me that all the engine builders I had seen at the exhibition had been grown adults, so how could I have been so daft as to think that this was something that a youngster could do?

They must have been laughing at me for even thinking it! If my twelve-year-old vocabulary had included the words 'arrogance' and 'hubris' then I would surely have directed them at myself without mercy. I was mortified.

Fortunately, dad chose that time to visit the garage with a cup of tea and to see how I was getting on. I explained the problem and so dad, being dad, calmly sat down, looked at the drawing, picked up the ruler and slowly and carefully began to explain the imperial measurement system to me, fractions and decimals and all. I suspect he had foreseen this eventuality, but thanks once again for your patience, dad!

Slowly, things started to make some sense. I began to understand the drawings and, after some practice, gathered the courage to cautiously transfer some of the specified dimensions to the pristine blued steel using ruler and scriber. I checked each dimension and scribed line twice, just to be sure, and, sure enough, some of my marks were wrong and had to be re-done. Although



Jumping ahead in the story, during her first steam test in 1984, the unpainted locomotive gently simmers in the May sunshine.

I didn't then realise it, I was intuitively following the age-old maxim: 'measure twice, cut once' which, in my opinion, remains the most important and fundamental lesson that anyone can learn when building anything. I have certainly regretted every time I failed to follow that rule since, on those unfortunate occasions, I've invariably proven the equally valid maxim: 'more haste, less speed!'

Over the course of the next few months, working when the light and temperature in the unheated and uninsulated garage was favorable, the frames, the buffer-beams and the main stretchers were marked out, the holes drilled, the cuts sawn and the filing, well, filed. By the end of the summer and to my happiness, almost all the lumps of steel bought at the show had been converted into something which resembled the items depicted in the book. Hooray!

In fact, there was only one little stretcher left to make, a small one that tied the top of the two mainframes

together. However, that stretcher presented a problem, a problem which could not be overcome with the drill, vice, saw or files alone. You see, this stretcher was cylindrical in shape and Mr. Evans, in his fine book, said that I would need a lathe to make it.

Lathe - that word again - and I still had no idea what one was or how to use it. That was now a real problem.

Postscript to Part 4

The creator of the Rob Roy design, as I'm sure most of you know, was another Martin Evans, our worthy editor's namesake. The prior Mr. Evans was, confusingly, also an editor of *Model Engineer* and published many designs and articles in this fine magazine both before, during and after his editorial term. His designs have remained enduringly popular over the years and many, many have been built. In late 1984, with my own Rob Roy recently completed and on display at an exhibition in west London, I was rather shocked to see the great man peering at her with apparent

interest. Unfortunately, I was too shy to introduce myself, something which I regret to this day, as I would have liked to have thanked him personally for the guidance and years of enjoyment which his efforts had provided me. However, with that option sadly closed, I will use this forum to say, posthumously, "Thank you, Martin Evans".

And finally, as you can probably see from the accompanying pictures, the Rob Roy book ended up living its entire life in the workshop. Flicking through the battered and stained pages today, I realise that the degree to which each page is fingerprint-stained provides silent testament to the degree of difficulty and complexity encountered at that stage of the engine's construction. In case you are wondering and perhaps unsurprisingly, chapter five is the most heavily smeared, dealing as it does with the assembly and setting of the inside Stephenson valve gear!

●To be continued.



Stuck Chuck

Dear Martin,
Anthony Mount (Postbag, M.E.4704, November 18th) refers to the stuck lathe chuck that I encountered. He suggests a method of removal by engaging back gear and using a piece of mild steel in the chuck and striking it against a piece of wood. Applying shock loading to cast iron back-gear teeth is something much appreciated by the lathe manufacturers, because they sell lots of spare gear wheels to people who have tried it over-enthusiastically. I would never adopt that procedure, especially as the Super 7 lathe has a spindle lock. I can assure Anthony Mount that his method would not have worked in the situation I was presented with because a) the drive key on the lathe spindle had already been sheared and b) even with the spindle removed and gripped in a vice it was simply not possible to apply sufficient torque to the chuck relative to the lathe spindle to release it. (Indeed, the torque that was applied to the long bar gripped sideways in the chuck was sufficient to distort the chuck body, as I discovered later when the jaws were found to be jamming in their slides.) I went for the only remaining solution of reducing the backplate to dust. The reason for the stuck chuck, as noted in *Club News*, was the amount of swarf in the threads jamming it up.

Keep your noses - and your chucks - clean!
Kind regards, Nigel Bennett
(Leeds SMEE)

Motor Rewind

Dear Martin,
I was interested in Graham Astbury's articles on rewinding a motor (M.E.4695 *et seq.*).

I have an Indesit two speed washing machine motor. The name plate says '2-pole, 2,800 rpm, 0.3 hp, 3½ amp or 12-pole, 420 rpm, 0.05 hp, 1.3 amp'. The torque on low speed feels similar to a 1/3 hp 1420 rpm motor by my way of measuring

Appeal from Doug

Dear Martin,
I have just completed my book on building BR Standard engines but I was just wondering if anyone else was daft enough to build any of the smaller locos to the works drawings. Anyway, I do know that several other people are building them and the detail is fantastic. I do know that Bob Shepard is building a beautiful 9F all to the works drawings and I have drawn up the Britannia, the 2-6-4 tank (which this book is all about), the Class 4 tender engine 75000, and I know of someone who is building a Class 2 to the works drawing but I have lost contact with him as Don young drew up the Ivatt Class 2 but he put BR tender axle boxes on it and just called it a BR class 2.

I am well on with drawing up the 76000 class and have recently joined the group who is rebuilding 76077 at the Gloucester and Warwickshire Railway from Barry condition and they are making great strides with that. I was just wondering if I might put a little plea in *Model Engineer* to ask if anyone else is doing anything similar as I want to include some of their photos in the book just to show what can be done when people put their minds to it. Mike Jack is building a Class 3 tank engine and he has gone to town on his engine, producing lots of lost wax castings for it, the same as I did for mine. On second thoughts, if people would also like send me any photos of building my engines as well I wouldn't mind that as I could also put a few photos on their engines in my book.

I think that is it for now.

Regards, Doug Hewson
(Barnetby-le-Wold, Lincolnshire)

Write to us

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Responses to published letters are forwarded as appropriate.

— by feel with a 'V' belt — very crude.

My parents had old Bendix washing machines with a sealed 2-speed motor. They changed speed with a multi-plate clutch operated by a solenoid. On low speed it had a lot of spare torque. I made a cement mixer with one.

The current on low speed (1.3 amp) seems high for 0.05 hp — not very efficient.

Yours faithfully, T. Scrase
(Finchampstead, Berkshire)

Tobin Bronze

Dear Martin,
I was interested in your comments on Tobin Bronze in *Smoke Rings* (M.E.4705, December 2nd),

Tobin Bronze is more a brass, sometimes in the UK known as naval brass, really just an ordinary 60/40 brass with a small (1%ish) addition of tin to improve corrosion resistance - cheap and cheerful! As with alloys of almost any metal there will be 100s of alloys, all slightly different, sometimes to save money, sometimes to improve

its properties, or environmental issues. In the case of Tobin Bronze, not a common term in the UK, specifications like B21(US) or CZ112/CW712R (UK) may ring bells but the alloy may have traces of lead (Pb), silicon (Si) or phosphorus (P), as well as 1 - 1.5% Sn, the balance being Cu/Zn. This material is available, though not as a thin rod of maybe 2 or 3mm, which could be used as a filler rod with a high temperature flux. Its melting point at 915 degrees C would be the next stumbling block, as many in the UK do not have the oxy/fuel brazing equipment that would be needed to reach this sort of temperature. With the boiling point of zinc at 907 degrees C there is a risk of porosity if the work is overheated and copper melting at 1083 degrees C could also be a problem so experience is needed. An easily obtainable filler that would work and has a much lower temperature is SIFCUPRON No17-2Ag, shown as Cu 92% P 6% Ag 2% with a melting point of 645 degrees C - 740 degrees C. With

increasing silver content are No17 - 5Ag and No17 - 15Ag, each with lower melting points but increasing cost. Another type would be SIF Silver Solder No 39, 32% Cu, 38% Ag, 28% Zn and 2% Sn, more costly again but with a slightly lower melting point and no phosphorus (P). For step brazing following the initial use of No. 39, then No. 40 and then No. 43 give decreasing melting points.

The method of constructing the boiler shell is interesting, with both brass brazing, joining/filling of the joint with a V fillet followed by a single butt strap riveted and silver soldered. The preparation of the joint and the need to maintain a 2 to 5 thou gap so that the braze will flow into the joint would not be easy as the metal comes up to heat. Whilst a drawn tube would require more work in adaption due to it being 1.85mm larger in outside diameter (4 inch bore X 10G wall) I feel this would avoid the above problems. If one was to use 12G tube then the outside diameter would be only 0.88 mm over size. The working pressure could be maximum 120psi at a safety factor of 10. (This figure is based on the calculations from Tubal Cain, E.L. Pearce, K.N. Harris and Martin Evans.) Anybody using the published design of shell construction would be well advised to seek the approval of their boiler inspector before starting!

Fire tubes should read 0.032 inch/21G but a wall thickness of 0.038 inch/20G is more likely to be available.

Noel Shelley (King's Lynn)

Dear Martin,
You posed a question about Tobin Bronze in a recent editorial and I offer the following observations if they are of interest or help.

I looked at the composition of SIF bronze brazing rods a few years ago and one answer for you is that these rods will be an equivalent to Tobin Bronze brazing rods.

As you say, Tobin Bronze is also known as Naval Brass and here is an indication that there

is potential confusion when identifying its composition. A brass is a mix of 65% copper and 35% zinc while bronze is 85% copper and 15% tin. These quantities are approximate and quoted for simplicity to illustrate the prime difference between the two, as each will often contain other metals in small percentages. Indeed, some bronzes contain 2% or more zinc and some bronzes contain tin. Tobin Bronze is really a brass with 0.75% tin and some silicon. Its namesake Naval Brass is resistant to sea water de-zincification and here it seems to be the tin inclusion that achieves this benefit.

The same confusion can arise for SIF bronze with most people thinking that it is a bronze material. These brazing rods can be melted under an oxy-acetylene flame and do a pretty good job of joining steel. But, SIF bronze No 1 is in fact a modified brass - around 59% copper, 40% zinc, plus around half a percent or so each of silicon and tin. (SIF bronze No 2 has around 9% nickel replacing some of the copper - information from Weldability SIF MSDS.) It is frequently referred to as a 'bronze' and used for 'bronze welding' but it is clearly similar in composition to brass with a high zinc content. I say similar because that 0.5% of tin may considerably modify the 'bare brass' behaviour. Probably some clever marketing many years ago with bronze being regarded as a superior and more expensive alloy.

Regards, Norm Lorton

Molesworth

Dear Martin,

I was most interested to read about the Molesworth pocket book in *Model Engineer* (M.E.4705, December 2nd). I have got one which belonged to my father and was a permanent item on his desk all through his life. It is a 27th edition which he had been given for his 21st birthday in 1917 while studying civil engineering at Glasgow University. The copy I have has got a Hurst's Architectural Surveyors Handbook included which increases the size to 1942 pages and means it is 4¾ by 3 by 2 inches thick. It is still in relatively good condition considering it is 105 years old.

Kind regards, Ross Dalziel

Dear Martin,

I have been reading through my latest issue of *Model Engineer* and came across illustration No.5 in the article *An Engineer, his Book and the Owner*. The illustration shows Abney's Pocket Reflecting level.

Some years ago, I was given an antique curio resembling this (see photo). To date I had not known the purpose of the device but the illustration in the magazine has solved this. My example was made by W. Watson and Son Ltd. of 313 High Holborn, London rather than W. H. Harling and is identical in many respects. I thought your readers may be interested in its operation.

The instrument is built on a square section tube with an optical eyepiece at one end. The other end has an inserted tube containing a fine horizontal wire lining up with the centre of the eyepiece and a 45 degree mirror angled to look upwards at the spirit level and again viewed via the eyepiece at the same time as the object whose level is being determined. When the object is lined up with the horizontal wire the moveable pointer is rotated until the bubble in the level centres on a cross line engraved on the glass vial, as viewed through the eyepiece and mirror.

In my example the pointer can be locked in position with a locking screw. The example in the article appears to have a wheel to rotate the pointer and no locking screw. The pointer and scale have a vernier protractor engraved on them.

If the instrument were to be set on a solid surface I believe it could be quite accurate but if hand held it would be quite difficult to get repeatable results.

**Regards, John Rogers
(Toddington, Bedfordshire)**



William Spence PART 14

Cliff Almond continues his description of a potential unusual narrow gauge 0-4-0T for 7¼ inch gauge.



Advanced thoughts and musings on the motion

First observations of the motion and drive to the wheels, when I was given permission to survey No.13 in the National Narrow Gauge Museum in Tywyn, Wales, lead me, at first, to consider it to be generally conventional in its layout and operation. At this time, I was only in possession of an A4 photocopy of the general arrangement drawings of the prototype, kindly provided from the archives of the museum. When reviewing this drawing, together with two slightly more detailed ones found after some online research, I discovered they formed part of the paper Samuel Geoghegan, Engineer to the brewery, presented to the Institution of Mechanical

Engineers at its Dublin Meeting in July 1888 entitled 'Description of Tramways and Rolling Stock at Guinness's Brewery'.

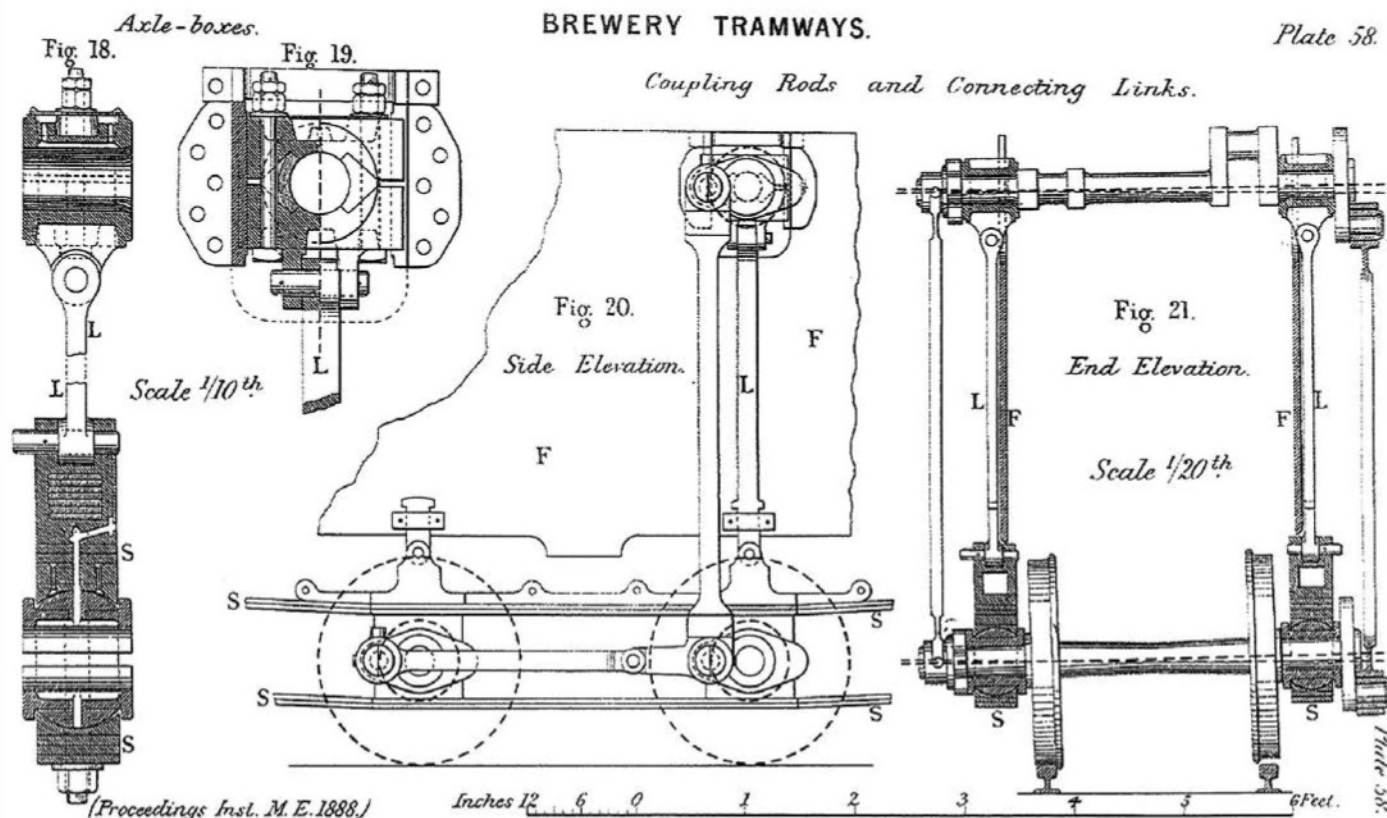
The paper consisted of over 50 pages covering, in some detail, many of the unique intricacies of the prototype. Initially, however, I was not aware of the document and it was not until some time later, during dialogue with the curator of the Guinness Brewery Museum in Dublin, that I discovered the existence of this valuable resource, which was very kindly made available to me in exchange for a copy of the general arrangement drawing I had, by then, produced for my 7¼ inch gauge version.

In this paper, Geoghegan describes having to overcome

'...sundry difficulties in considering the principles of the design...' of the locomotive.

The first of these was how to connect together the upper and lower pins, and the associated shaft between them, in such a way as to allow for the oscillation of the two shafts, due to the defects in the track, without interfering with the true bearing of the brasses on their respective pins. One must remember that much of the track around the brewery had been laid in the preceding years to accommodate, mainly, horse-drawn trucks, that did not require such a 'smooth' layout. Reference to **fig 12** describes the issue Geoghegan faced and designed, with 'L' describing the vertical connecting rods.

Fig 12



The question arose as to how much movement would it be necessary to allow for in the axlebox? Geoghegan considered that $\frac{3}{4}$ inch would be sufficient. However, when the locomotive was in an inclined position i.e. whilst traversing the spiral tunnel he describes, in his paper, '...how much out of alignment the two shafts appeared...'

To overcome this, Geoghegan goes on to describe '...the thinning down of the ends of the vertical connecting rods 'L' near the crank pins, to allow them to 'spring' whilst, at the same time, maintaining their cross-sectional area...'

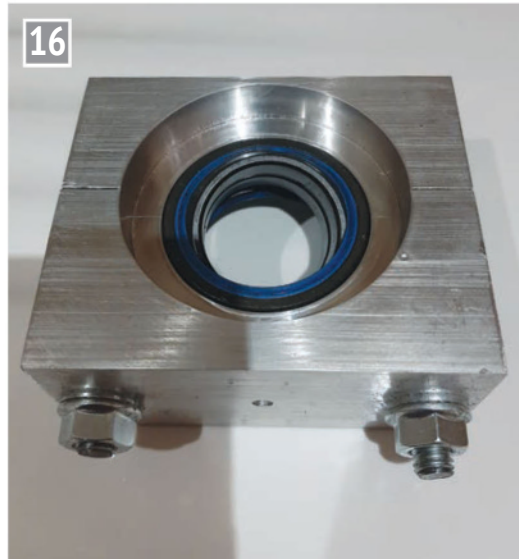
On the model this is challenging to replicate, due to the very much shorter length of these rods when compared to the prototype i.e. one third of the original's length.

Whilst the overall profile and section of the rods on the model will replicate those on the prototype, there can be no reliance on them flexing. Some thought has been given to making these rods from a spring or a high carbon content steel, such as EN8, with some experimentation to establish a section that would allow some flex. However, I concluded that the section would be quite slender and would eventually either fail or permanently deform, given the weight of the model and the continuous impact that will be transferred from undulations in the track, through the wheels and up through the rods.

However, if no deflection is allowed for, then the chassis will be 'locked' in position, leading to premature wear in the various bearings, and inevitable derailment.

A not dissimilar situation is present on traction engines, where the rear-driven wheels and the crankshaft need to have fixed centres, in order to maintain the drive through the gearing.

Of course, on a 'conventional' locomotive this situation does not exist because all of the motion is horizontal and on the same



Finished axle boxes.



Axle box journals being finish turned.

centre line, with the axle boxes being able to move up and down within their respective horn guides, essentially tracing a rotational path.

On the model, the intention is to replicate this by allowing the crankshaft bearings to move up and down to match the flex in

the bar frames. This is achieved by fitting small coil springs to the bearings, essentially replicating the conventional locomotive practice of axle boxes in horn guides.

In the next article I will describe this in more detail. In the meantime, I have included

images of the axle box bearings that are now ready to assemble (**photos 16 and 17**), after finish-turning the axle box journals to receive the sealed roller bearings (**photo 18**).

●To be continued.

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Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.771
M.E. 4705, 2 December 2022

The Stationary Steam Engine

PART 41 – MATTHEW MURRAY AND THE ROUND FOUNDRY (cont.) The last legal skirmish

The completion of Matthew Murray's new engineering factory in Leeds confronted Boulton and Watt with their most formidable challenge. For five years Murray had disregarded their legal menaces and by the time that the patents lapsed he had built at least ten engines, almost certainly all with separate condensers (ref 210). When threatened with legal action, other builders had retreated from using condensers until after 1800 but Murray's persistence gave him a lead which he used to build up his expertise. The end of the patents levelled the field and future competition should have been a matter of price, quality and salesmanship but one final joust in the patent tilyard remained.

In March 1799, Watt's legal representatives alerted him to Murray's application for a steam engine patent. Watt had no information about the content and he proceeded to raise a caveat that blocked progress until he could obtain details. Lawson was asked to enquire and on the 30th March he wrote that the engine was rumoured to work without a beam or condenser, to cost less than half of the current price to build and save one fifth in fuel. In spite of Lawson's role as Boulton and Watt's agent, he and Murray were on amicable terms and, in a probably calculated manoeuvre, Murray confirmed what Lawson already knew and revealed further details;

the engine had a horizontal cylinder with no flywheel. Evidently there was nothing in Murray's patent that might be construed as an infringement and the caveat was allowed to lapse. Patent No. 2327 was sealed on the 16th July 1799 but proved a damp squib. It proposed an impractically long, horizontal, double-acting cylinder. Rotative motion was to be achieved by gears and jamming clutches working on screwed axles. Even before it passed into law Murray had realised that it was a chimera.

Patent 2327 may have lacked substance but the threat that Murray posed as a patentee served as catalyst at the Soho Foundry. The response was Murdoch's patent 2340 of August 1799. In the first week of April 1799, between Lawson's letters relating to Murray's patent, Watt wrote to M. R. Boulton:

We have had some conversation with Murdock about ... the Steam Engine Patent ... the following articles might be specified:

1st a new method of boring Cylinders and turning Cast Iron (the worm drive).

2nd a new method of constructing valves of Steam Engines by means of sliding valves connected together &c. (the slide valve).

3rd a new method of working the valves of Steam Engines by means of hollow stems &c. (concentric valve stems).

4th a new method of constructing the Cylinders and Steam Cases of Steam Engines

by means of conical joints &c.

5th a new Rotative Engine.

6th another new rotative engine.

... I am not quite confident that some of the above articles may be contestable upon the grounds of prior use but I think it may be worth our while to run the risk for the sake of the advantage of a patent... Murray's Patent is a stimulus to us to be active... (ref 211)

Even though Watt's letter was the template for the patent, Murdoch's final specification was taken out independently of Boulton and Watt. It was addressed from Redruth, Murdoch's Cornish home rather than Soho.

Murray retaliated by raising a blocking caveat. His intention seems to have been to irritate rather than serious opposition and Murdoch's patent passed into law on the 29th August 1799.

Within twelve months of Murdoch's patent Murray sealed his second steam engine patent, No. 2531 of the 4th August 1801. It had six parts under the omnibus title:

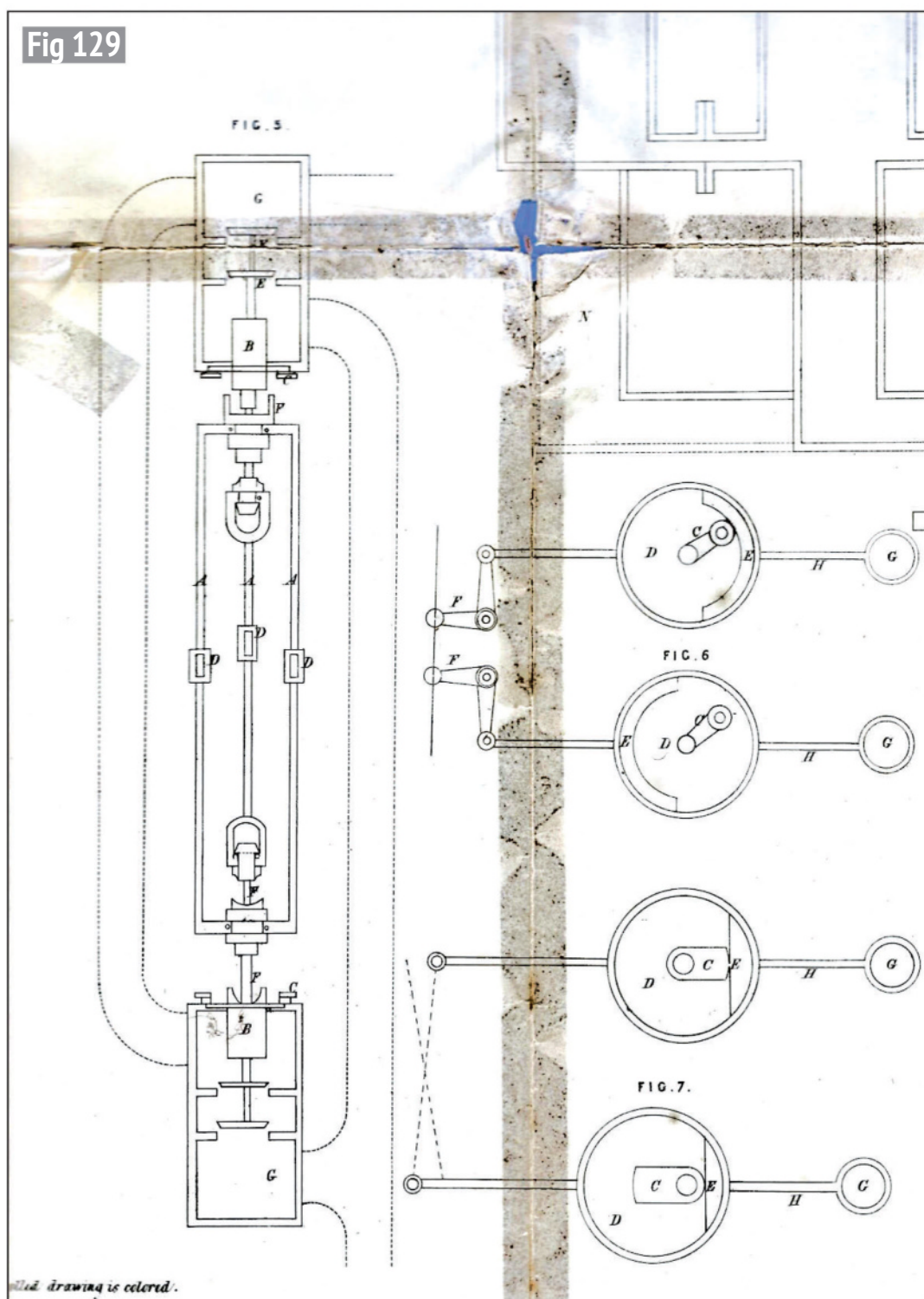
Certain New Methods and Improvements of Constructing the Air Pump and Sundry other parts belonging to a Steam Engine by which considerable Saving will be made in the Consumption of Fuel and Increased Power Obtained.

The master subject featured in the title, alterations to the arrangement of the air pump, followed Murray's argument that disposing of both air and water by the use of a single pump consumed

more power than would be entailed in using two separate pumps. In addition to the use of twin pumps Murray also suggested as an alternative to pumps, creating the vacuum by a vertical draught tube exceeding 28 feet in length.

Supplementary to the main topic, protection was claimed for a means of avoiding uneven settlement of the cylinder cover when the packing was placed directly between the cover and the cylinder flange, a cause of misalignment of the piston rod gland and the piston. Under the patent the cylinder cover was formed as a deep bowl, the parallel sides of which fitted closely into the cylinder bore. The outward projecting flange of the bowl sat in a recess counterbored into the cylinder flange. This gave machined, metal-to-metal contact with no packing between to disturb the alignment. A junk ring spanning across the width of the cylinder flange and the cover flange was bolted to the cylinder flange, compressing the packing.

Watt dismissed the above proposals as being of dubious utility but other parts of the patent were taken more seriously. From the early seventeen-eighties Boulton and Watt had standardised upon a toothed sector and rack working within the nozzle box to lift the valves. The sector was mounted on a spindle that passed through a stuffing gland in the side wall of the valve box. Each valve box had two of these valves, one for the inlet and one for the exhaust. The assembly was expensive to manufacture and called for skilled fitting and maintenance. Murray's arrangement was simpler and cheaper. His inlet and exhaust valves were of the usual poppet type working vertically onto seats placed one above the other, in a circular cast-iron valve box (**fig 219**). The innovation came with the valve design and the means of lifting the valves. The valve heads were mounted on spindles which passed out of the valve box through a gland



Murray's patent 2531 of 1801. The concentric valve spindles and the wiper eccentric.

set into either the top or the bottom cover of the valve box. By passing one valve spindle concentrically through the hollow spindle of the other, only a single gland was required between the interior and the exterior of the valve box. There was no mechanism within the valve box to cause mischief.

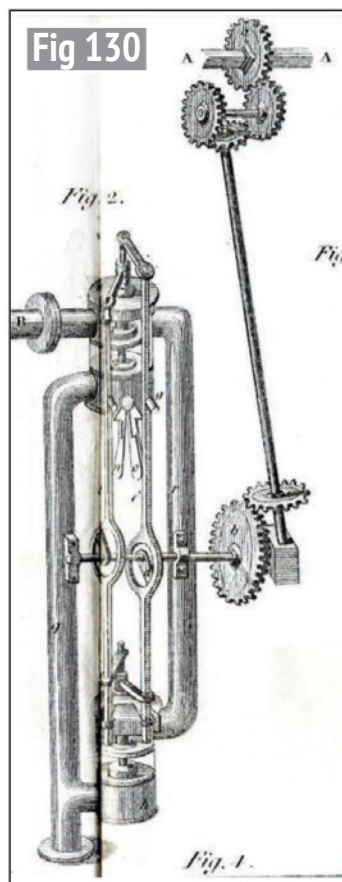
The circular valve boxes were placed in their usual position at the top and bottom

of the cylinder with separate down-pipes linking the inlet and the exhaust halves of the two boxes. The inlet and exhaust valves were connected by rods, each of which had a square mortice hole forged into its centre. One arm of a bell crank was inserted into the hole and the rocking action of the bell crank raised and lowered the rods, opening and closing the valves

(**fig 130**). To oscillate the bell cranks Murray proposed to use a wiper arm cam revolving on an axle driven by gears from the crankshaft. The wiper arm was encircled by an eccentric ring with rubbing strips and it was the reciprocation of this eccentric ring that drove the valves.

Concentric valve spindles are not mentioned in the text of Murray's patent and this

feature is only apparent from the drawing. As patents were not published before 1852, Watt's agent would have to inspect the master copy at the Chancery Lane (ref 212) to understand it fully although it is possible that a working example was seen; the first appears to have been erected at Carr's Dyeworks, Swinegate, Leeds in March 1801, after the patent had been deposited but six months before it was sealed. In fact, over twelve months passed before Watt was sufficiently confident to reach for the legal bludgeon. Because there was no Boulton and Watt patent to be offended it was doubtless Weston who suggested the use of *scire facias*, a judicial writ requiring Murray to demonstrate why the patent should stand in the face of proven prior usage. The argument was to be that Boulton and Watt had already used concentric valve spindles for the Mint engine. A drawing



Matthew Murray's concentric valve stems and valve gear using gears rather than eccentrics to drive the spindles. *Treatise on Mechanics*, Olinthus Gregory 1805.

for this engine showed two eccentrics operating poppet inlet and exhaust valves with concentric spindles passing through glands in the covers of the nozzle boxes but it would seem that although these valves were tried in November 1798, when the machine was set to work five months later, it had reverted to the older type of valve (ref 213). This weakened the claim to priority for the Mint engine so it was then suggested that an engine built for the Symon's Reading Brewery might form a second line of evidence. This apparently made use of a valve spindle passing through a stuffing box in the top of the valve chest but only a single spindle would be required as it used Murdoch's slide valve. Symons' engine remained at the works for some months before it was delivered in September 1799.

It is worth emphasising that Watt had included the concentric valve spindle as item 3 in his original proposal for Murdoch's patent but it was withdrawn before the specification was published. The reason almost certainly lies in Watt's final paragraph that:

I am not quite confident that some of the above articles may be contestable upon the grounds of prior use but I think it may be worth our while to run the risk for the sake of the advantage of a patent.

Nor was any form of eccentric or wiper cam mentioned in either the proposal or the patent in its published form. The substance of Boulton and Watt's case was purely one of demonstrating that both inventions were in use at Soho before Murray's patent was deposited. Watt believed that there was sufficient internal evidence within the company to prove that this was so. Demonstrating prior usage alone would have made *scire facias* effective but Watt was pathologically intent on proving that Murray had profited from industrial espionage. Assembling the evidence took a further six months.

Initially the source of information on the matter was a workman named Crowden who, after leaving Soho, spent about six weeks with Bateman and Sherratt in Salford before going to Murray. The Boulton and Watt engine erector Gavin had been present when Crowden and Murray were discussing Soho affairs and Lawson was tasked with interrogating him:

... respecting the seduction employed by Murray & also respecting the conversation which the latter held in his presence & that of W. Harrison about the hollow spindles & his means of obtaining intelligence of our proceedings. Please also to enquire whether Lawson has obtained any information from Crowther (Crowden).

Lawson reported back but implicated Murdoch (W.M.) rather than Crowden:

... Gavin says that at the time that W.M. & Murray were drunk together (in Leeds) with himself and company, every sort of scheme was drawn with chalk on the floor, whether this was amongst them he is not certain ... (but) ... all that Gavin knows of Murray knowing of the valves is Murray's saying he knew of all of the new schemes at Soho and particularly the new valves, describing them by a motion of the hand often used for other purposes...my modesty prevents me from saying more. (ref 214)

Crowden however remained the main subject of enquiry and Lawson had information concerning:

... the conversation he had with Murray (which) took place on a Sunday at the Cross Keys public house in Holbeck ... he is sure it was before Xmas 1799... Murray asked him if he had seen the new nozzles at Soho or the Mint ... he told him he had but would not say further than that they worked the valves with rods through a stuffing box ... asked him how the valves worked inside ... he could not explain as he had never seen more than the outside...

Gavin was dubious about the reliability of Crowden's knowledge as he had not seen the Mint engine in detail but the fact that the

information was said to have been passed to Murray in December 1799 weakened the case as Murray's patent had already been lodged by that time. It therefore became important that Watt should push the date back to a point where it anteceded the patent's deposition. Attention turned to the occasion when Murray visited Birmingham having been promised a reciprocal tour of the Soho Foundry works by Murdoch. This visit took place between the 20th and the 26th of May 1799 but Murray was refused access to the Soho Foundry. Greatly offended, he used the opportunity to have a detailed discussion with Soho employees in a public house during which:

... he ... told Wm Harrison & Gavin that he knew of the new nozzles we were making and of all we were doing at Soho or had a spy who informed him of all of our proceedings ... This you will observe was at least six months prior to his conversation with Crowden ... (ref 215)

By Gavin's account these discussions took place on the 27th or 28th May at The George in Digbeth.

By the end of summer Soho had made drawings to show the old and the new valves for comparison. There was also a drawing of the eccentric as applied to Symons bell crank engine and another showed valve actuation by a rotating shaft. 1801 Murdoch had also made a series of models and Watt was ready to consolidate his evidence. The brief took each item of Murray's patent in turn and disparaged it either by asserting lack of novelty, failure to improve upon the existing practice or in the case of the concentric valve idea that the invention was Murdoch's and first used on the Mint engine November 1798 followed by Symonds Reading Brewery engine in September 1799. It was argued that Murray's valves were an exact copy of the latter and that he had gained his knowledge from a Soho workman. In support, it

was stated that Murray had admitted in May 1799, that he knew they were making valves upon this construction and had a spy in their works who told him of all they were doing.

Murray was now inclined to temporize and his lawyer wrote in June 1803:

Solely with a view of avoiding the Expence and Trouble of bringing up witnesses from remote parts... we propose on the part of Mr. Murray to grant Messrs. Bolton (sic) & Co., full licence to make use of his inventions & improvements on the steam engine provided the present proceedings are discontinued and that he will not afterwards grant the same licence to any other person.

In a reply saturated with moral rectitude, Watt dismissed the offer but as the case approached the court date it was obvious that Murray had conceded. Watt reported to Boulton that, with Weston, he had contacted Murray's solicitors but they said Murray was proving elusive. He had only been seen twice, on both occasions, drunk. After further pursuit Murray was cornered and agreed to withdraw the suit. *Scire facias* was informally conceded.

None of the parties emerged with credit although Watt published a triumphalist vindication in *The Leeds Mercury* for Saturday 23rd July 1803:

The King against Murray. ... The Prosecution was carried on at the instance of Messrs. Boulton and Watt & Co., of Soho, whose principal view in the Repeal of the Patent was to expose the Defendant's Conduct in obtaining by the seduction of their workmen a knowledge of ... the modes of constructing and manufacturing Steam Engines ... at their works and founding a Patent thereon claiming merit and assuming an exclusive right to the reward due to the labour and ingenuity of others.

Watt said they had shown that those parts of the specification which Murray claimed were new, had merit

or which he claimed to have originated he had:

... surreptitiously become acquainted therewith ... the other articles of the Specification were impracticable or trivial ... in short to show that whatever was useful in this patent was not new and that whatever was new was not useful.

This statement, widely circulated in other local newspapers, gave the impression that the case had reached court but this was not so, the judgement against Murray was one by default although the upshot was the same - Murray's patent was void notwithstanding which it continues to be enshrined in the patent records to this day. Nor was Murray prepared to conclude the matter without a characteristic outburst of impudence:

PATENT STEAM ENGINE MANUFACTORY,

Leeds, July 20th, 1803.

I feel myself called upon to vindicate my Character as an ENGINEER, against a foul Insinuation in a Paragraph inserted in the Newspapers of last week, I suppose by Messrs. BOULTON, WATT, & Co.; they assert, "that every Improvement which was really new and useful, and deserving a Patent, in the one which I obtained in the year 1801, was invented and practised at their Works, and that I surreptitiously obtained a Knowledge thereof from some of their Workmen." I do positively deny, that I ever got the least Hint of the Improvements in Question from any one; indeed a little Observation is sufficient to refute their assertion: If I knew that these Improvements had been invented and practised at Soho, I must have been deficient in Common Sense, as well as Honesty, to attempt to obtain a Patent for what I knew I could not hold. Had they used my Inventions in the manner described in that Patent, prior to the date thereof, they certainly would have practised them in the Engines they made before that Period, or taken out a Patent for the Improvements themselves.

The Reason of my not defending the Patent was, not from any Fear of losing ... but that I did not think proper to defend it with such expense as I should most probably have incurred, in contending with such rich and powerful Opponents as Messrs. BOULTON, WATT & Co. But had I been guilty of obtaining a Knowledge of their Improvements, if they had any, (but I do not believe they have made any worth Notice since Mr. Watt, Senior, retired from the management) it would only have been return in kind. Mr. STOREY, manager of their Foundry, and Wm. MURDOCK, Superintendant of the Workmen at Soho, some time back visited our Works at Leeds, and from their assuring us of Messrs. BOULTON, WATT & Co.'s friendly disposition, were admitted into every Part of the Manufactory, by Mr. WOOD and myself; they were permitted to take Patterns and Specimens of our Workmanship, and we know that upon their return to Soho, many of our Improvements were immediately adopted, and the Engines made after that by them, were in part constructed on our Plans. Mr. MURDOCK upon taking his leave of us expressed a wish, that as they and we were certainly the best Engine Makers in the Kingdom, ... that if ever I should go to Soho, they would be very glad to shew me all their Works. I did go to Soho, and was refused admittance...

But the World, I believe, cares very little about Messrs. BOULTON, WATT, and Co.

stealing my Inventions, or my stealing theirs; what people want ... are good engines ... I am confident I can make good ones; and as they hint that no one can do that but themselves, I am willing to end this dispute, ... in a similar mode to one they proposed to Mr. HORNBLOWER, with whom they had a dispute some years ago, when Mr. WILSON, their Agent in Cornwall, gave him a Challenge for £1000. that Messrs. BOULTON and WATT, would produce an Engine superior to that Mr. HORNBLOWER had erected at Tincroft Mine; this Challenge Mr. H. did not accept.

Now I offer (by way of Trial and Proof of Ingenuity and Workmanship) to make an Engine of one Horse Power, against any one of the same Power made by BOULTON, WATT & Co; and I offer to deposit in the Hands of any Banker in London, if they will do the same, One Hundred Guineas; to become the Property of the Party whose Engine is declared to be most perfect and useful by twelve Practical Engine-Makers, six to be chosen by BOULTON, WATT & Co. and six by me, MATTHEW MURRAY.

What would have been a memorable contest never took place.

● To be continued.

NEXT TIME

We look at the development of the steam engine after Watt's patents expired.

REFERENCES

210. Matthew Murray 1765-1826, Paul Murray Thompson. Op. cit. Appendix 2.
211. Murray Thompson op. cit. p. 87, B & W ref. MSD3147/3/48/27.
212. The Patent Office as a separate institution was not established until 1852. Patent examination by the Patent Office began in 1884 but there was no investigation for novelty before 1905.
213. Murray Thompson op. cit., p. 127 quoting B & W MS3147/2/61/4 and Dickinson and Jenkins op. cit. p. 189.
214. Lawson to MRB. 12th December 1802. PMT 115.
215. 23rd June 1803 Lawson to Watt Jnr.

Is it Possible to Insulate Small Steam Pipes Effectively? PART 2

Mike Tilby discusses options for reducing heat loss from models.



Continued from p.23
M.E. 4706, 16 December 2022

The first part of this article described the processes that contribute to heat loss (i.e. conduction, convection and radiation). It also explained why lagging a pipe could, in principle, cause an increase in heat loss rather than a decrease. This is because of the resulting increase in circumference (and hence area) of the outer surface. The resulting increase in convection and radiation can outweigh the decreased conduction. This effect is likely to be particularly marked with small diameter pipes where adding a layer of insulation will result in a larger percentage increase in surface area than is the case with large pipes.

The first part also showed that, unlike the situation with many pipes in the industrial world, when calculating heat

loss from miniature pipes, it is important to take account of loss by radiation, in addition to conduction and convection because surface temperatures are likely to be higher.

Inclusion of radiation loss increases the complexity of the calculations because the rate of each of the three processes depends on the temperature at the surface of the lagging but, at the same time, that temperature depends on the rates of all three processes. Furthermore, although rates of heat loss by convection and radiation both depend on the difference in temperature between the surface and the surroundings, they show markedly different patterns in the way they increase with increase of temperature, as was described in part one.

Calculation of heat loss with radiation

As was mentioned previously, a spreadsheet can be downloaded (from **ref 6**) that performs a fairly complicated calculation of heat loss from pipes, taking into account all three heat transfer processes. In this calculation, pipe heat loss is first calculated by assuming the surface temperature is one degree higher than the ambient temperature. Using this value it calculates:

- * Resistance to heat loss by conduction.
- * Heat transfer coefficient and resistance to heat loss by convection.
- * Resistance to heat loss by radiation.

Based on the results from these calculations it calculates revised values for the overall rate of heat loss and for

surface temperature. It then uses these revised values as the starting point for a second round of calculations which results in improved values for heat loss and surface temperature. Three further successive rounds of calculation give values which no longer change significantly and can be taken as the final result.

The following graphs are all based on these calculations.

Heat loss from small un-lagged pipes

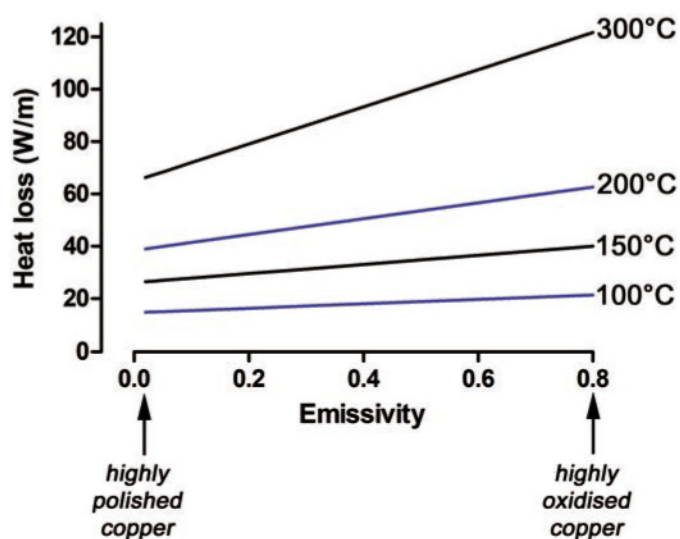
Having dealt with a lot of theory, we can now use the spreadsheet to investigate the effectiveness of lagging pipes of a size likely to be used on model steam engines. We'll start with $\frac{5}{32}$ inch diameter copper tube with 22g wall, although variation in wall thickness makes no significant difference to the results.

In order to assess the effects of lagging it is important to know the rate of heat loss from a bare pipe but this in itself is not straightforward because it depends on the pipe's surface finish. It was explained in part one that the rate of radiation of heat from a surface is influenced by the property known as emissivity. **Table 1** shows that emissivity of polished copper can be very low (0.02) whereas copper that appears black due to heavy oxidation can be 40-fold higher at 0.8. However, the impact that this variation in emissivity has on overall heat loss from a bare pipe is much smaller than 40-fold and depends on the steam temperature. With steam at 300 degrees C, polishing a highly oxidised copper pipe can give up to a 46% decrease in heat loss while for steam at

Table 1 - Emissivity of various surfaces

Material	Finish	Emissivity
Aluminium	Anodized	0.7 - 0.9
	Polished	0.05
	Oxidised	0.1
Brass	Polished	0.03
	Oxidised	0.61
Carbon	Soot	0.95
Chromium	Polished	0.1
Copper	Polished	0.02 - 0.05
	Oxidised	0.65 - 0.85
Fibre glass		0.75
Glass	Smooth	0.95
Hard wood	Along grain	0.7
	Across grain	0.82
Hessian fabric		0.88
Iron	Rusted	0.93
Paint		0.9
Stainless steel		0.59
Steel	Galvanised	0.28
	Freshly rolled	0.24
Tin plate		0.06

Fig 5



Effect of surface finish on heat loss from $\frac{1}{2}$ inch diameter metal pipes carrying steam at 300, 200, 150 and 100 degrees C. (Data generated using the spreadsheet in ref 6.)

100 degrees C the reduction is only about 30% (fig 5). Most pipes may only exhibit a low degree of oxidation and this means the emissivity will be in the range 0.2 - 0.6, so the benefits of polishing may be limited.

Heat loss from small lagged pipes

Figure 6(A) shows the predicted surface temperature of lagging on a $\frac{1}{2}$ inch diameter copper tube with 22g wall, carrying steam at 150 degrees C. Each curve represents the temperature for lagging with the indicated conductivity at thicknesses between 0.1 and 8mm. It can be seen that the surface temperature decreases progressively with increase in thickness of the insulation and the decrease also becomes more pronounced as the conductivity of the insulation material is reduced.

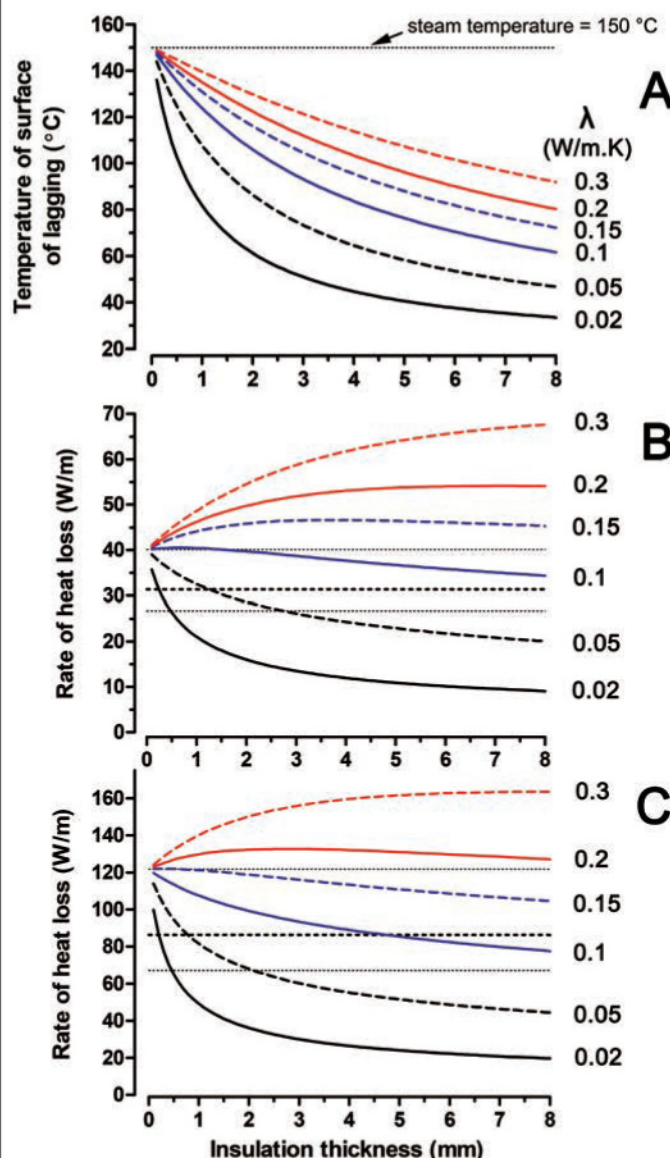
Figure 6(B) shows the rate of heat loss per metre of the same pipe. Each curve represents the rates of heat loss for insulation with the same range of conductivities and thicknesses as in fig 6(A). For these graphs the

emissivity of the lagging was taken as 0.8 since that is typical of most lagging materials. This high value immediately puts lagging at a disadvantage compared to a lightly oxidised bare copper pipe.

The upper, middle and lower horizontal dotted lines in fig 6(B) indicate the rate of heat loss from un-insulated pipes with emissivity values of 0.8, 0.3 and 0.03, corresponding to heavily oxidised, lightly oxidised and highly polished copper respectively.

The curves show clearly that, depending on its thermal conductivity, the effects of lagging can range between markedly decreasing to markedly increasing heat loss. Furthermore, whether a useful decrease in heat loss is achieved very much depends upon the surface finish of the un-lagged pipe. For example, starting with a lightly oxidised copper pipe, (heat loss = 31 W/m) adding 0.1mm thick lagging of any type increases heat loss to 40 W/m, because of its increased emissivity. Increasing the lagging thickness increases resistance to heat conduction.

Fig 6

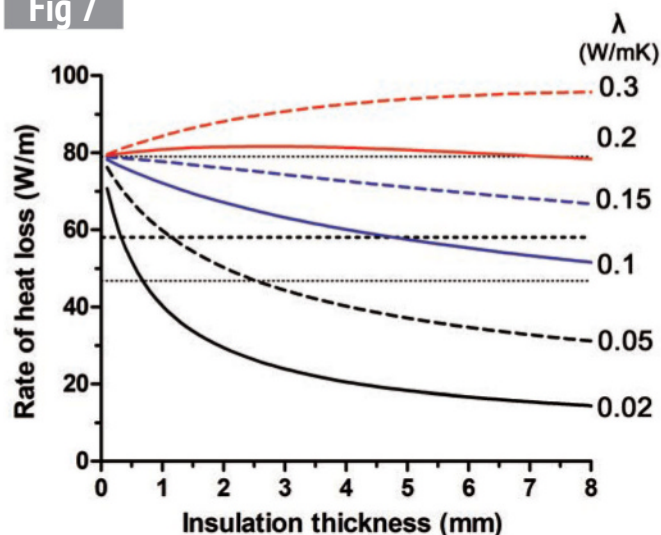


Effect of conductivity and thickness of lagging material on A: the surface temperature of the lagging; B and C: rate of heat loss from a pipe of $\frac{1}{2}$ inch outside diameter, carrying steam at 150degrees C (A, B) and 300 degrees C (C). Each curve represents the calculated value for insulation with the indicated thermal conductivity at thicknesses between 0.1 and 8mm, assuming an emissivity of 0.8 for the outside surface of the insulation. The horizontal dotted lines in B and C indicate the rate of heat loss from an un-insulated pipe with surface emissivities of 0.8 (top line), 0.3 (middle line) and 0.03 (bottom line). (Data are based on calculations in the spreadsheet from ref 6.)

This is seen in the reduced surface temperature which decreases loss by radiation and convection. However, increasing lagging thickness

also increases the area of the outer surface which increases loss by radiation and convection. When the lagging has a low efficiency

Fig 7



Effect of conductivity and thickness of lagging material on rate of heat loss from a pipe of $\frac{3}{8}$ inch outside diameter, carrying steam at 150 degrees C. Each curve represents the calculated value for insulation with the indicated thermal conductivity at thicknesses between 0.1 and 8mm, assuming an emissivity of 0.8 for the outside surface of the insulation. The horizontal dotted lines indicate the rate of heat loss from an uninsulated pipe with surface emissivities of 0.8 (top line), 0.3 (middle line) and 0.03 (bottom line). (Data are based on calculations in the spreadsheet from ref 6.)

(e.g. conductivity = 0.2 W/mK) the effect of the increased area outstrips the reduced conduction and the overall rate of heat loss increases with increase in thickness. If a more efficient lagging is used (e.g. conductivity = 0.05 W/mK) the overall rate of loss decreases with increased thickness such that, when its thickness is 2mm, the heat loss is roughly the same as for the non-lagged pipe.

Figure 6(C) shows data equivalent to panel B but for a steam temperature of 300 degrees C. As is to be expected, the higher temperature results in higher rates of loss but the lagging has a slightly more beneficial effect than at the lower temperature.

As pipe diameter is increased, addition of similar thicknesses of lagging makes a smaller impact on surface area than for smaller pipes. This results in the insulation

giving a greater benefit for $\frac{3}{8}$ inch diameter pipe compared to $\frac{5}{32}$ inch pipe (compare **figs 7** and 6(B)).

Insulation materials

It can be seen from the above discussion that to obtain a useful reduction in heat loss the lagging on small diameter pipes needs to have the lowest possible conductivity but **table 2** shows that very few suitable materials are available, especially when they must withstand the temperatures of superheated steam. Also, the lagging needs to be reasonably robust since being compressed would decrease its effectiveness.

String

A material that is widely used for lagging small pipes on models is string and that was the insulation Peter had used when he noticed it made matters worse. He used the common white round

Table 2 - Thermal conductivity values
(values from ref 8 except where indicated)

Material	Thermal conductivity (W/mK)	Comments
Copper	380	Values for metals are just a guide. Actual values depend on the alloy composition and temperature.
Duralumin	164	
Iron	55	
Steel	40	
Cotton (densely packed, conduction along fibres)	1.88	Data from Ref. 7
Carbon	1.7	
Cotton (densely packed, conduction across fibres)	0.36	Data from Ref. 7
Hardwood (e.g. oak)	0.16	
Softwood (e.g. pine)	0.12	
Wool felt	0.07	
Calcium silicate	0.055	Max. temperature = 650 degrees C
Paper	0.05	
Neoprene	0.05	
Balsa wood	0.048	
Rockwool insulation	0.045	
Glass wool insulation	0.04	
Sheep wool	0.03	
Kapok insulation	0.034	
Cotton wool	0.03	
Expanded polystyrene	0.03	Max. temperature = 75 degrees C
Aerogel blanket NT1310	0.023	Max. temperature = 650 degrees C
Urethane foam	0.021	Max. temperature = 120 degrees C
Aerogel	0.018	

soft string about 2mm in diameter which seems to be made from cotton. I could not find a conductivity value for string (which is probably not surprising if it is only used for thermal insulation in the world of model engineering). Values of 0.04 to 0.05 W/mK are reported for various types of woven or knitted cotton cloth, but the conductivities will be greatly influenced by the amount of air trapped in the fabric and by the orientation of the cotton fibres. The low conductivity of insulating materials is generally due to trapping air inside some sort of matrix since air has a very low conductivity. The above-mentioned values for cotton

fabric were similar to that for cotton wool (0.03 W/mK) and so probably reflect loosely packed structures, whereas in string the cotton fibres are quite densely packed. The only source of relevant information I could find (**ref 7**) described experimental data for fibres packed at maximum density and this reported that conductivity along cotton fibres was much higher than across the fibres, with values of 1.88 and 0.36 W/mK respectively.

I imagine that in string, the cotton fibres will be largely oriented along the strand so that when used as pipe lagging, heat conduction will be across the fibres. Therefore, ➤

it seems likely that, in the present context, conductivity will be less than 0.36 W/mK. The string is at least twice as dense as woven cotton cloth but well below the maximum density analysed in ref 7, so its conductivity is probably in the region of 0.1 to 0.2 W/mK. Figure 6 indicates that 2mm thick lagging of this conductivity around a lightly oxidised $\frac{5}{32}$ inch copper pipe would cause an increase in heat loss compared to a bare pipe. Some people have painted the string white. This looks attractive but the paint will fill up some of the air spaces in the string and so it is likely to increase the conductivity and hence increase heat loss. (Paint colour does not significantly affect emissivity for infra-red radiation).

Is it possible to effectively insulate small steam pipes?

This brings us back to the question posed in the title and the answer depends on how low is the conductivity of available insulation material. Of the common materials, the lowest conductivity is seen with urethane foam, but this is not suitable for steam pipes because it has a maximum working temperature of only

120 degrees C. At present, the only temperature resistant material I know of, that has a similarly low conductivity is Aerogel with $\lambda = 0.018$ W/mK. This is said to be the lightest solid material known to mankind and it was only quite recently developed commercially (ref 8). It seems that NASA are involved in developing improved versions of this (ref 9). However, the original Aerogel is rigid and so is not suitable for wrapping around a pipe.

There is another product, which consists of Aerogel particles over a matrix of fibreglass. It is a semi-flexible blanket and is available in a grade able to resist 650 degrees C (ref 10). The conductivity of this is slightly higher at 0.023 W/mK. However, the conductivity was measured at 20 degrees C and I have read with regard to a similar product, that conductivity increases with increase in temperature. (So far 'Aerogel UK' have not replied to my enquiry about their product.) This blanket material is expensive and only seems to be available in a large roll. Small pieces of what seem to be similar products are available on eBay, but they are of less certain quality. Assuming these pieces are equivalent to the branded

product, this type of matting seems to be the best attainable insulating material for steam pipes etc. From fig 6 it can be seen that a conductivity of 0.023 W/mK should give a useful reduction in heat loss.

A less satisfactory alternative might be to wrap strips of a loosely woven or knitted cotton fabric around the pipe since this could give a conductivity of about 0.03. However, cotton deteriorates slowly at temperatures above about 140 degrees C and so is really only suitable for extended use at low steam pressures and low degrees of superheat.

In industry, a widely used robust lagging material for high temperature pipes is calcium silicate. Its conductivity is 0.056 W/mK at about 250 degrees C and, for large pipes, this is fine. But even if it were available in a form suitable for

models, any lagging material with a conductivity above about 0.05 W/mK is counter-productive and one would get better results by polishing a copper pipe. However, the polished surface would soon re-oxidise, especially at high steam temperatures. A better solution might be to wrap aluminium foil around the pipe or electroplate the pipe with zinc. This is because, unlike copper, for both of these metals, the oxide layer that eventually forms on them has a low emissivity (about 0.1). Wrapping aluminium foil around the outside of string lagging should also give a reduction in heat loss but calculations indicate that the effect would be so small that it is probably not worth bothering with.

ME

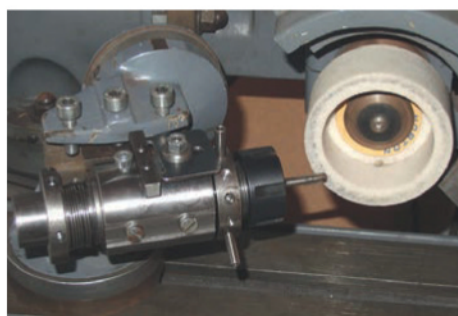
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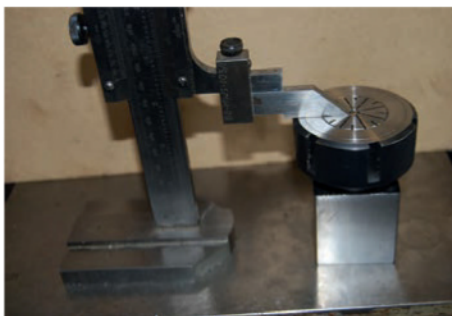
No.324

Look out for the February 2023 issue:

MODEL ENGINEERS' WORKSHOP



Jaques Maurel on tap sharpening.



Martin Berry makes a collet block stop.



Laurie Leonard shares what he's learnt about casting metal.

On Sale 20th January 2023

Club Diary 3 January - 5 April 2023

January

3 Taunton Model Engineers

Meeting, Stoke St. Mary village hall – 'Lots Road Power Station' by Tim Griffiths, 19:30-21:30. See www.tauntonme.org.uk

4 Bradford MES

Bits and pieces evening, Saltaire Methodist Church, 19:30. Contact: Russ Coppin, 07815 048999

4 Bristol SMEE

Talk : 'Railway Level Crossings', Begbrook Social Club 19:30. BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

5 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

5 Warrington and District MES

Natter night, St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

8 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

8 Sutton MEC

Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

15 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

17 Taunton Model Engineers

Meeting, Stoke St. Mary village hall, 19:30-21:30. See www.tauntonme.org.uk

18 Bristol SMEE

Small, non-locomotive engines evening, Begbrook Social Club 19:30. BS16 1HY. Contact: secretary@bristolmodelengineers.co.uk

19 Warrington and District MES

Talk – Dr Mark Caplan, 'Enter with caution – X rays', St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

22 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

29 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

February

1 Bradford MES

Talk – Geoff and Mary Twentyman, 'The Low Moor WW1 Explosion', Saltaire Methodist Church, 19:45.

Contact: Russ Coppin, 07815 048999

2 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

2 Warrington and District MES

Natter night, St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

5 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

5 Small Model Steam Engine Group

Open meeting, 14:00-17:00. See www.gmes.org.uk

7 Taunton Model Engineers

Meeting, Stoke St. Mary village hall, 19:30-21:30. See www.tauntonme.org.uk

12 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

12 Sutton MEC

Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

15 Bristol SMEE

'Modelu' (small model figures), Begbrook Social Club 19:30. BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

16 Warrington and District MES

Talk – Geoff Stocker, 'Rebuilding the Welsh Highland Railway', St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

19 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

21 Taunton Model Engineers

Meeting, Stoke St. Mary village hall – 'More Engineering Tales' by David Hartland, 19:30-21:30. See www.tauntonme.org.uk

26 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

March

2 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

2 Warrington and District MES

Natter night, St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

5 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

7 Taunton Model Engineers

Meeting, Stoke St. Mary village hall with Dave Morris, 19:30-21:30. See www.tauntonme.org.uk

10/11 National Model Engineering Exhibition

Harrogate show ground. More details to follow.

11/12 Midlands Garden Rail Show

Warwickshire Event Centre. See www.meridienneexhibitions.co.uk

12 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

12 Sutton MEC

Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

15 Bristol SMEE

The Camerton line, Begbrook Social Club 19:30. BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

16 Warrington and District MES

Talk – John Hastings, 'Building the Patriot steam locomotive', St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

19 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

21 Taunton Model Engineers

Meeting, Stoke St. Mary village hall – Annual General Meeting, 19:30-21:30. See www.tauntonme.org.uk

23 Sutton MEC

Afternoon Run from 12 noon. Contact: Paul Harding, 0208 254 9749

26 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

26 Guildford MES

Open day, 14:00-17:00. See www.gmes.org.uk

April

1 Bradford MES

Annual exhibition and competition, Saltaire Methodist Church, 12:30-16:00. Contact: Russ Coppin, 07815 048999

2 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

2 Small Model Steam Engine Group

Open meeting, 14:00-17:00. See www.gmes.org.uk

2 Taunton Model Engineers

Public running at Vivary track, 14 :00. See www.tauntonme.org.uk

4 Taunton Model Engineers

Meeting, Stoke St. Mary village hall, 19:30-21:30. See www.tauntonme.org.uk

5 Bradford MES

Boating bits and pieces evening, Saltaire Methodist Church, 19:30. Contact: Russ Coppin, 07815 048999

Performance Testing an Electric Motor using a Dynamometer PART 1

Graham Astbury determines the output characteristics of a rewound electric motor by building a dynamometer.



Introduction

I had rewound a single phase two-speed motor for different speeds than for which it was originally wound (**ref 1**). As the design of the new windings was subject to a lot of estimation, I realised that I should really measure the output of the motor to check its performance. Having looked through the available literature, I discovered that there appeared to be a simple method of determining the performance of an induction motor from two simple tests: the 'no load' test and the 'locked rotor' test.

These are described by Langsdorf (**ref 2**) who uses the two tests to plot a 'circle diagram' from which the entire performance of the motor can be derived. The characteristics that can be derived are the power input and output, phase currents, torque, speed, efficiency and the power factor. It also allows the estimation of the copper losses, the iron losses and the windage and friction losses. Such a diagram is stated by Langsdorf to be drawn '...with an accuracy sufficient for most purposes...'. However, plotting a circle diagram relies on the motor having the same voltages and currents on each phase and balanced phase angles between each phase - in other words, it is suitable only for three-phase motors on a balanced three-phase supply. In my case, the motor is fed from a single-phase supply and it is made into a nominally two-phase motor using a capacitor to derive the second phase from the single-phase supply. Consequently, not only does it have unbalanced phase voltages and currents but unequal phase angles too, so this approach was obviously

Nomenclature	
A	Current, amps
C	Capacitance, μF
e	Base for natural or Napierian logarithms (= 2.718281828459)
f	Frequency, Hz
n	Speed, rpm
P	Power, watts
R	Measured resistance, ohms
R_{ref}	Cold resistance, ohms
t	Elapsed time, minutes
T	Time constant, minutes
V	Volts
W	Torque, newton-metres
Z	Impedance, ohms
ΔT	Temperature rise, K
Θ	Temperature degrees C
Θ_0	Initial temperature, degrees C

a non-starter. I needed to actually measure the power output under operating conditions, so some form of measurement of the torque and the speed, and hence power output, was required.

There are several ways of doing this - and all rely on a method of measuring the speed and the torque developed whilst the power is absorbed in some form of load. This can be achieved by fixing a flat belt pulley on to the motor, placing a flat belt over the pulley and attaching a spring balance to each end. This is a brake dynamometer. The difference between the readings of the two spring balances multiplied by the radius of the pulley gives the torque and, by measuring the speed, the power absorbed can be calculated. Whilst this is simple, there is a problem that all the power is dissipated in the brake and so not only the belt, but also the pulley, get rather hot. An alternative

is to absorb the power by driving an electric generator and dissipating the power in resistances which can be large and air-cooled, or small and water cooled as in an immersion heater.

The first idea using the pulley and flat belt required not only a flat pulley but a piece of heat resisting belt and two spring balances. I had a suitable three-inch diameter flat pulley but had neither a piece of heat resistant belt nor two spring balances. This left the second option of using a generator or dynamo and dissipating the generated power in some form of resistance capable of dissipating the power. These resistances were simple to find - use car headlamp bulbs as the load, just as Jon Freeman had when describing his test methods (**ref 3**). As I had an old Lucas C39 car dynamo in the 'Engineering Stores', I decided that the electrical method of absorbing power



The old Lucas C39 car dynamo.



The Lucas RB340 current voltage regulator.

would be better than the mechanical means (photo 1).

The first incarnation

I had the simple idea of coupling the dynamo directly to the motor output shaft using a flexible coupling and supporting the non-drive end of the dynamo with a centre and then measuring the force required to prevent the dynamo rotating by using kitchen scales. The manufacturers of the dynamo had very kindly provided an oil-hole at the non-drive end which had a 90 degree centre formed in it – ideal for support. As the motor was expected to have an output of up to ¼ hp or 180 watts, the dynamo seemed ideal as it was rated at 19 amps at 15 volts – an output of 285 watts, which would mean it could absorb all the likely power that the motor



The coupling in pieces.



The coupling assembled.

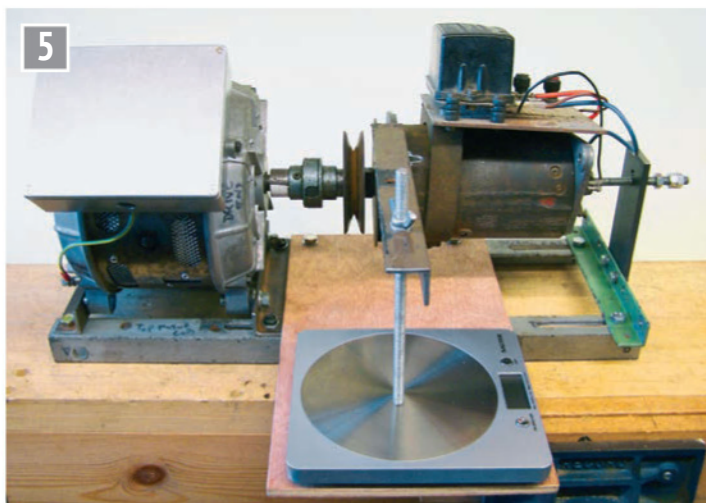
would produce. I had used the dynamo many years ago to provide a 12 volt DC supply in the workshop by driving the dynamo with a ½ hp motor and it had lain under the bench unused after I had moved house. I dug it out only to find that it would not self-excite, so I suspected that the control box that went with it was the problem (a Lucas RB340 control box - photo 2).

This control box had been acquired by the usual method of scrounging other people's unwanted items and had originally worked previously for the 12 volt supply. Clearly, a case of neglect – the contacts had become oxidised and just needed a clean with some very fine abrasive paper to make it work again. For those born after about 1970, cars in the UK were fitted with dynamos until the early 1970s when alternators became the norm for cars. The advantage of the old dynamo and control box was that often they could be repaired at home – unlike modern cars where everything is electronic or computerised and only serviceable on an 'exchange' basis.

To connect the dynamo to the motor, I used a 'spider' coupling (photos 3 and 4) which has a fairly hard rubber spider which fits between the two parts of the coupling providing a small amount of flexibility, so I thought that it would allow for any slight

angular misalignment between the motor and dynamo shafts. As the dynamo pulley was originally secured with a ¼ inch UNF nut, I made a bush which fitted into the bore of one part of the coupling and tapped it to screw on to the dynamo shaft to replace the original nut. I made a similar bush to fit other half of the coupling to the motor which had a 14 mm diameter shaft. The small screws visible in photo 3 were originally used to secure a small fan to the coupling as it had been used to drive a vacuum pump.

The next part was to make a frame to support the motor, with a cross piece at the end, spaced to fit the dynamo in between the end of the motor shaft and the centre support mounted on the cross piece. This is shown assembled with the dynamo in photo 5. As the rewind motor had new synchronous speeds of 750 and 1500 rpm, the actual speeds would be more like 725 and 1450 rpm.



The initial driving arrangement.

After a lot of head scratching and Internet searching, I found that the type of flexible coupling I had used was designed for the connection of two *rigidly-mounted* rotating machines and definitely not for the purpose for which I had 're-purposed' it.

As this was much less than the regulator cut-in speed for the dynamo, I tried it with the field directly connected to my workshop 12 volt DC supply and measured the output voltage which was around 5 volts on the low speed 725 rpm winding. Doubling the speed to 1450 rpm would double the voltage to about 10 volts. I reasoned that, whatever the voltage that was produced, it would be less than 12 volts and therefore I could safely connect one or more automotive headlamp bulbs as a load. I could dispense with the regulator, which had a voltage-controlled cut-out which required 12 volts to operate, as the maximum voltage would always be below the rating of the headlamp bulbs.

I built a 'dummy load' panel consisting of several car headlamp bulbs mounted into a plywood base panel with a vertical screen to shield the bright lamps with each lamp connected via a switch to a bus-bar connecting to directly to the dynamo (**photo 6**). The large wire-wound resistance at the end is an 11 ohm 2.5 amp resistor scrounged from a battery system for switchgear tripping and the bulb next to it is a 12 volt 24 watt bulb. This set-up allows increases in load from 1 amp up to 22 amps in about 1 amp increments – more than enough for the dynamo in use.

On assembling the motor and dynamo with the coupling between them into a frame, I fitted a short arm to the dynamo to press down on to a set of kitchen scales so that the torque could be determined from the load on the scales (**photo 5**). The dynamo was fixed axially to

the motor, but restrained from rotating by the arm pressing on the scale pan. I could re-set the zero on the scale to take the weight of the arm and any imbalance of the weight of the dynamo into account.

On trying this out on the low speed, there was a problem with vibration. Although the dynamo did generate all the power needed, it made the reading on the scales vary wildly so that a reliable reading could not be obtained. On re-connecting the motor for the high speed of 1450 rpm, the vibration was so bad that the bolts securing the motor to the test bed came loose. I quickly terminated the test at this point and retired to my phrontistery for a good long think. (A phrontistery is a 'thinking place', from the Greek *phrontistēs* - 'deep thinker'.)

After a lot of head scratching and Internet searching, I found that the type of flexible coupling I had used was designed for the connection of two *rigidly-mounted* rotating machines – with the rubber element able to take up any minor offset or misalignment of the two shafts – and definitely not for the purpose for which I had 're-purposed' it. No wonder there had been a lot of vibration as the dynamo was free to move slightly out of alignment with the motor shaft. On the low speed this had been tolerable but too much to allow a steady reading to be obtained on the kitchen scales, whereas on the high speed, the vibration had increased far too much – as the speed had doubled, the vibrational forces would quadruple – in line with (speed)². Definitely a case of thinking out the problem after the event rather than anticipating it.



The car headlamp bulbs forming the dynamo load.

Torque measurement

I carefully considered how best to re-arrange the dynamometer to avoid the problem of misalignment yet still have some way of measuring the torque. Commercially available small torque meters are available in the form of a short shaft and measure the torque by using a pair of strain gauges each positioned at 45 degrees to the shaft axis to measure the twist imparted to the shaft by the torque. This could be mounted directly onto the motor shaft and the flexible coupling then fitted between the torque meter and the dynamo, with both the

dynamo and the motor rigidly mounted. The readings would be taken using slip-rings to feed to an amplifier to give a reading of the torque. An alternative is to use a small radio transmitter mounted on the shaft and a receiver connected to the display, using radio control frequencies. These had a torque capability far larger than I required and were too expensive for me to purchase. They were too far out of my experience to be able to attempt to build one myself. Consequently, a different method had to be devised.

●To be continued.

REFERENCES

1. Astbury, Graham, *Rewinding a motor for two speeds*, Model Engineer, issues 4695 to 4606.
2. Langsdorf, Alexander S., *Theory of Alternating-current Machinery*, 2nd Ed., McGraw-Hill Book Company, Inc., New York, 1955.
3. Freeman, Jon, *Petrol Engine and Alternator Sets*, Model Engineer, **225**, 642 et seq. (2020).

Wainwright's Swansong

The End of an Era

PART 5

Nick Feast builds a 3½ inch gauge version of one of the last of the elegant Edwardian locomotives.



Continued from p.35
M.E. 4706, 16 December 2022



The next item to describe is the smokebox. This is basically a brass tube, 4¼ inches outside diameter and 3½ inches long with a section removed at the bottom, to clear the cylinder assembly and the sides bent outwards to sit inside the frames.

Photograph 41 shows the construction. Here I am making sure that the holes I have drilled for the hinge pin are square to the cast-in smokebox door hinge straps. Unfortunately, the first effort

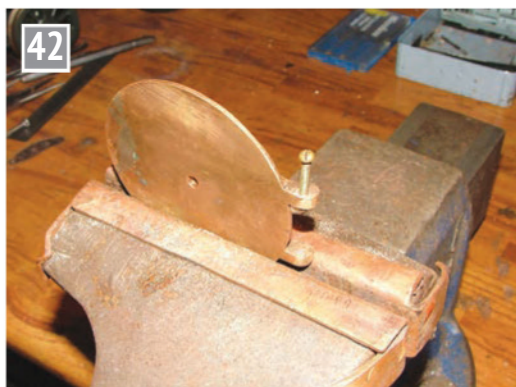
went adrift and **photo 42** shows remedial action in progress. I have cut a thread in the errant hole and inserted a brass screw. This will be silver soldered in place and a new hole drilled in the correct place.

Photograph 43 shows the smokebox in position on the frames so that the position of the blastpipe can be marked on the exhaust casting. I am using a pendulum suspended from a piece of thread through the middle of a wooden

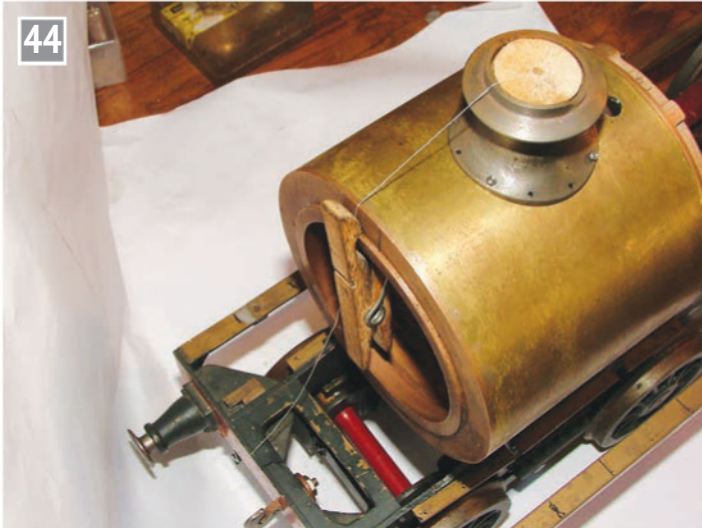
dowel in the chimney. The frames have to be dead level, of course. This view shows the rather neat cast bronze mating ring that is used to join the boiler barrel to the smokebox, in order to minimize



LEFT: A neat smokebox door casting with integral hinges came with the engine. There is a single central fastening with a dart as opposed to the peripheral dog clamps of many Southern engines. It is essential to get the hinges dead horizontal. Crooked hinges, wonky chimneys and drunken dome covers will ruin the look of your engine. **RIGHT:** I have had to fill both the original holes to get the hinge pins in the right place.



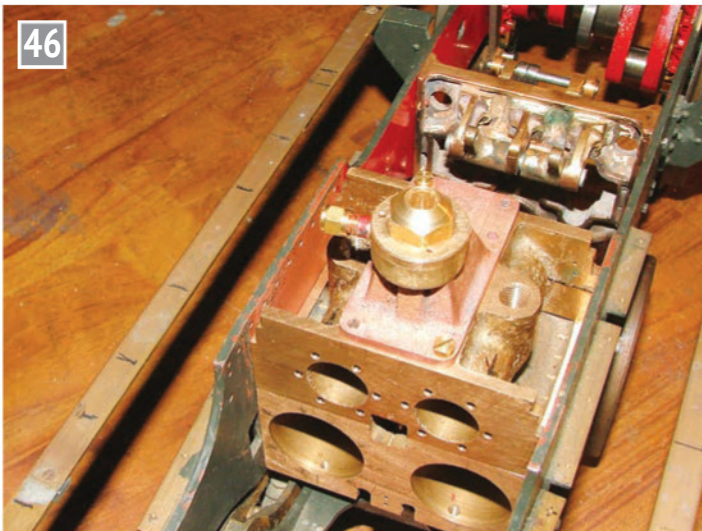
The holes for the snifting (anti-vacuum) valves are visible on the top of the smokebox behind the chimney. These will actually be dummies; a larger working valve will be installed out of sight under the front footplating. The boiler cladding will sit on the outer diameter of the joining ring; it will be supported on steel crinolines along the rest of the boiler.



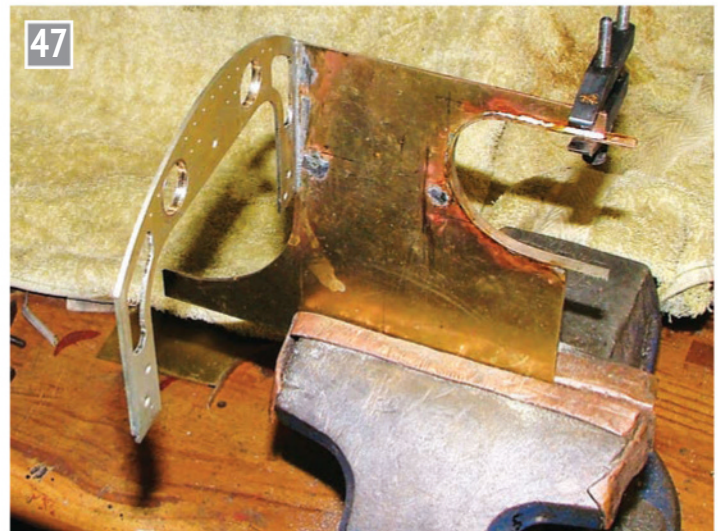
44 Use of a plumb bob to centre the blastpipe as on the full size. The front and rear end sections of the smokebox needed to be silver soldered as temperatures here will melt soft solder.



45 There is enough spare tube to be able to cut off the piece that is in the vice which has been squashed a bit out of round.



46 The position of the blastpipe has been set and the hole for the nozzle spigot drilled and tapped. The blast nozzle holds the hollow blower ring and cap in position. There are three holes in the cap of around 1mm diameter, angled inwards slightly to the middle of the chimney.



47 I used a combination of large soldering iron and small gas torch to heat up the cab parts for soldering. The beading is cut well oversize and is trimmed to size and drilled for cab stanchions later. There will also be a lot of filing to achieve the correct oval profile.

the chance of air leaks into the smokebox. Also note the elegant cast iron chimney that only featured on these locomotives for a few years. During the 1920s smokeboxes and chimneys were changed to the Maunsell L1 type. Unlike the D1 and E1 locomotives, the L1 was not a rebuild of an older engine but a new class. The Ls continued as a complete class to the end.

Photograph 44 is another view of the same – and showing another use for the multipurpose clothes peg.

Referring back to fig 2 earlier in the series, the petticoat pipe was a straightforward trumpet

shape so here I have machined up a suitable piece of broom handle to work as a former in a piece of $\frac{7}{8}$ inch outside diameter copper tube (**photo 45**). Several annealings were required but it did not take long. A steel sleeve inside the chimney has a short spigot at the bottom and a setscrew to hold the petticoat pipe in place, so that it can be removed if required.

Photograph 46 shows the blastpipe and blower ring installed; as mentioned earlier, the voids either side of the valve chest will be covered with brass sheets so that the bottom of the smokebox

can be sealed against air ingress. In the past I have used fire cement as per full size but it is much cleaner and easier to use one of the high temperature silicone sealers as used on woodburner chimneys etc. If one surface is coated with high temperature grease first, then it is usually possible to separate and rejoin components, several times if necessary, without losing the seal.

Moving on to the cab and splashers, there is a real dilemma here. If this is going to be a working model rather than a decorative exhibit, it not only has to be capable of being

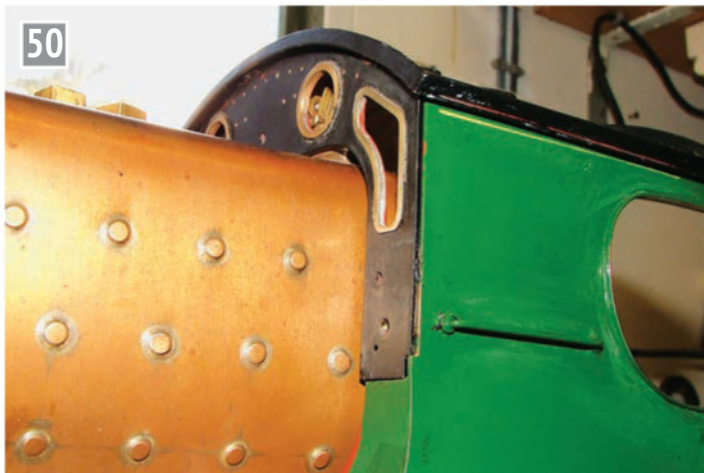
driven but also maintained. No matter how good the quality of the boiler construction, and even if the locomotive has had little or no use since its last boiler test, it will need retesting every four years if it is going to be used at a public track. Although not essential, it is preferable to remove the boiler from the frames if possible. Not many regulators will be leak tight against test pressure, so it is necessary to blank off the steam pipes in the smokebox. The boiler tester may also want to have a look inside the firebox for leaks, bulges etc. **Photograph 47** shows how I initially intended to build the



The cab beading has been finished in this photo and I have fixed small brass angle brackets to the sides of the splashers to support the tops. The folding cab doors are also fitted, as is the angle to support the seat tops.



Construction of the cab roof hinges is complete; the next task is to try and fit everything into the limited cab space. Silver soldered elbows for the injector steam valves sit on top of the firebox, either side of the whistle valve.



I have started the painting and lining but setting the position of the cab relative to the boiler was tricky. A piece of 2.5mm brass angle will be bent to the firebox profile to cover the gap.

cab. The spectacle plate has been soldered to one of the sides and I am soldering some flat brass strip around the cab cutaways, these will be shaped to the required oval section *in situ*. However I soon realised that with the cab assembled like this it would be impossible to remove the boiler without totally dismantling the cab and splashers and probably ruining the paintwork in the process. **Photograph 48** shows the revised method. The splashers are fixed to the cab sides but the spectacle plate is removable and is located on blocks soldered to the cab sides as shown. It can be released and slid up out of the way when boiler removal is needed. The cab roof is also completely detachable.

The hinged cab roof arrangement was covered in M.E. 4623 and 4624 back in late 2019 (refs 4 and 5). **Photograph 49** was used then to show how the roof hinges were arranged. **Photograph 50** shows how the spectacle plate and cab sides are fitted together. Precise cutting of the sheets is required but a small allowance must be made for the thickness of the paint or it will chip off. The circular window frames are a simple turning job but the kidney shaped lookouts are fabricated from 00 gauge nickel silver rail.

Photograph 51 shows a little more progress; the boiler has been insulated and clad with nickel silver sheet. There is just room for the spectacle plate to



The brass beading has now been fitted to the cab and splasher sides and I have begun the boiler cladding. Unscrewing the rear sandbox filler lids and a couple of screws under the footplating will release cab sides and splashers as one unit for any future dismantling.

fit over the top, the remaining gap will be covered by $\frac{3}{32}$ inch (2.5mm) brass angle bent to fit. This has to be removable and is made in two halves.

●To be continued.

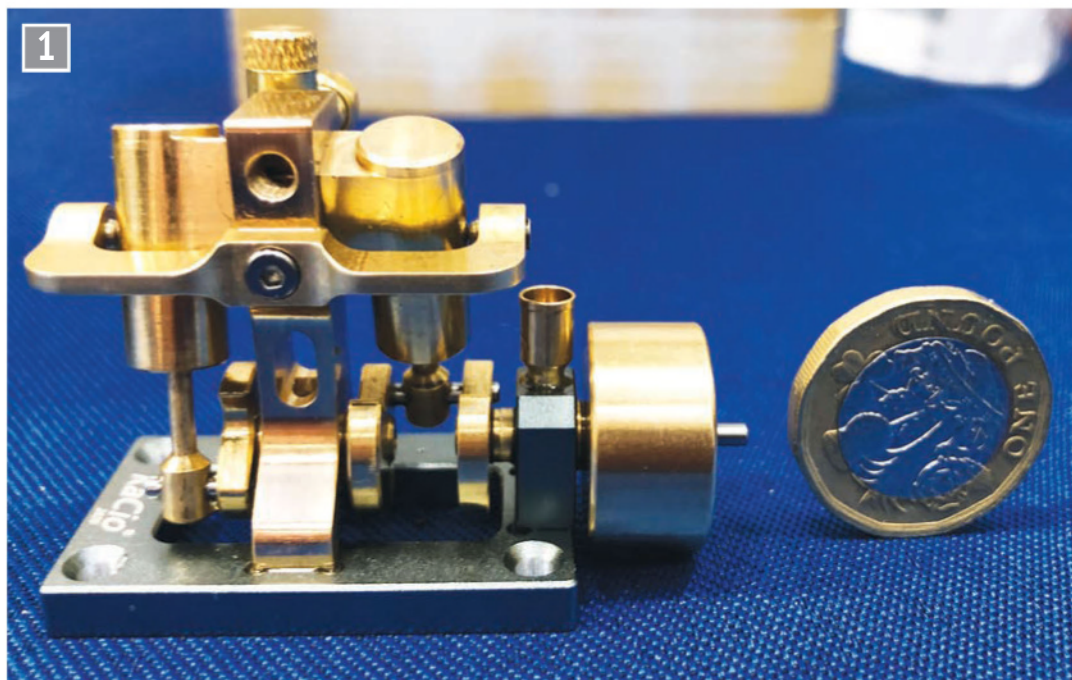
NEXT TIME

The next major job is to make the crinolines and clad the boiler.

REFERENCES

4. Model Engineer 4623, 11 October 2019.
5. Model Engineer 4624, 24 October 2019.

Julie Williams welcomes the return of the Lowestoft Model Engineering Exhibition.



Dave Fountain's tiny double cylinder oscillating engine.

LOWMEX 2022

Lowmex, the much-acclaimed model engineering exhibition, was back with a bang! It was held at a new venue, the Energy Skills Centre building at Lowestoft East Coast College, which meant that there was more space for displays, comfortable visitor movement and easy parking.

The clocks went back on the last Saturday in October, giving the exhibitors a very welcome extra hour in bed so they could re-charge their batteries ready for the Sunday. I would like to give you a small taste of what was on show there.

Halesworth and District Model Engineering Society (HDMES) is the parent

club (LOWMEX being an independent subcommittee) and those members presented a large and varied display of models, forming the core of the exhibition in the main hall. One of the smallest exhibits displayed here was a mini double cylinder oscillating steam engine, not much bigger than a £1 coin (**photo 1**) built by Dave Fountain. The single exhibit featuring the largest number of individual models was by Andy Belcher and Chris Nobbs. It included a small selection of Andy's vast collection of 16mm scale locomotives running on the War Department Light Railway of the Western Front 1917, his Darjeeling Himalayan Railway and Chris's Penrhyn Quarry Railway (**photo 2**). Andy and Chris had another, separate display as well, running 16mm scale live steam in another room. The model of the earliest locomotive prototype was of a 7¼ inch gauge Stephenson's *Locomotion* (**photo 3**). It is a work in progress by Kevin Rackham, with his own



A vast array of 16mm rolling stock.



Kevin Rackham's 7 1/4 inch gauge Locomotion.



A 75 ton breakdown crane by Charlie Lovett of Phoenix Model Engineers. (Photo courtesy of Peter Joyce.)



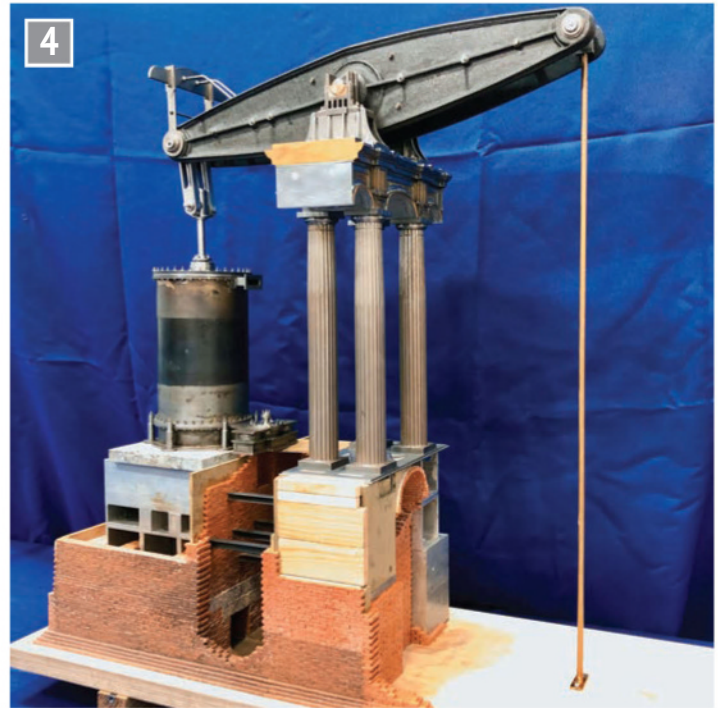
Charlie Lovett's LNER Gresley combined dining and First Class compartment carriage.



The interior of the LNER carriage.



An impressive display of locomotives on the Ipswich club stand.



John Child's Cornish waterworks pump.

modifications of the original and the Reeves design, in that the model boiler sits in a semi-circular chassis to which all the motion will be fixed (thus eliminating over fifty fixings into the boiler which would create potential weaknesses). Kevin has three years to finish the model so it can be displayed to celebrate *Locomotion's* bicentenary.

Another very impressive model in progress was John Child's 1:24 scale model of a 90 inch Cornish waterworks pump (photo 4). It is about 25% complete and John has spent around 600 hours on it so far and laid over 7,000 miniature bricks of the 12,000 needed!

HDMES did not display the biggest exhibit in the main hall though; that accolade went to Charlie Lovett of Phoenix

Model Engineers for a working Cowens, Sheldon & Co. 1962 75 ton breakdown crane (photo 5), all scratch built with a total length of 12 feet! Charlie had also completed his LNER Gresley Teak, Diagram No. 5, combined dining and First Class compartment carriage during Covid lockdown. The fine detail includes tiny cups and saucers, knives, forks and plates on the tables (photos 6 and 7). A 120 kilo working masterpiece.

Moving away from the HDMES display there were other clubs with impressive exhibits. The Ipswich club displayed, in Hall 2, several gauge 1 live steam models (photo 8) as well as 3 1/2 and 5 inch gauge locomotives along with a nice 1:12 scale Minnie.

On leaving the main hall the first thing the visitor saw was Mark Reynold's very impressive Galleon (photo 9) made from a 1:75 plank on frame Billings kit, the *Norske Løve*, which had been in Mark's loft for about 30 years; he completed it in about 9 months during the Covid lockdowns. The detail is remarkable, even down to graduated threads for the different rigging and over 2,000 knots. Mark also made the cabinet from sweet cherry wood and 1/4 inch Perspex.



Mark Reynold's galleon, the Norske Løve.

There were a further fourteen rooms to explore away from the two main halls, containing hundreds of models displayed on over 300 tables and filling floor space. Other model clubs displayed scale model boats, planes, railway layouts in Gauge 1 and 16mm live steam, quirky models by Gary Edwards (**photo 10**) as well as an excellent, extensive model fairground floor layout in the refreshment hall (**photo 11**) plus some outside exhibits (although the unkind weather put paid to a lot of the outside events). The college had one room with virtual reality goggles (amazing!) and a 'build your own' wind turbine; another room featured an impressive bridge simulator, where you could manoeuvre a ship through the Gull Wing bridge at Lowestoft into the inner harbour. It made you realise just how easy it must have been for the cargo ship, *Ever Given* to block the Suez Canal!

There is always a 'stand out' model for visitors to exhibitions, for whatever reason: a reminder of childhood; an ambition; an engineering challenge ... there are so many reasons and each choice would be different. Not so at Lowmex! The majority of visitors would, without a doubt, have said that the most memorable experience about the exhibition was The Daleks. Did you know that Daleks have a sense of humour? Did you know that they exchange 'knock-knock' jokes with 'small humans' and that they pose for photos saying 'cheese'? They do 'high-fives' with their sink plunger (they also said we were to be careful as they had unblocked the loo with it that morning). Did you know that they could 'elevate' (go in a lift) so that no-one was safe from them? Lowmex Daleks did all of that – and much more. One of them joined forces with the Cyberman, who fist bumped with the children, and together they took over the



A selection of figures from Gary Edwards.



This model fairground was to be found in the refreshment hall.

Bridge Simulator (**photo 12**) and started looking for Dr. Who to 'exterminate'. They didn't find him, although the Doctor's car, the 1954 Ford Siva Edwardian, displayed by Lewis Barnes, was in the main hall with Steve Elphick's Tardis, both guarded by Mathew Rackham's remote-controlled dog, K9 (**photo 13**).

Lowmex is on course to make a small profit, which will be donated to the local

charity SOLD Studios, (Special Objectives for the Local Disabled) which, like so many charities at the moment, needs all the support they can get.

Discussions have already started about next year's Lowmex, so make a note in your new 2023 calendar for October, it promises to be even better.

ME

W. www.lowmex.co.uk



They seek him here, there and everywhere. Who? That's right!
(Photo courtesy of the Lowestoft Journal.)



Still no sign of Dr. Who.

Geoff Theasby reports on the latest news from the Clubs.



First a correction and an apology. In M.E.4702 the caption to photo 1 erroneously referred to Brighton. This should have read Bournemouth. I apologise to Chris Bracey, Keith Burrige and B&DSME.

There appears to be an eddy in the space-time continuum (what's he doing there?) in between my basement workshop and the rest of the house. I spend maybe 10 minutes down there and, when I return, birthdays have come and gone, dynasties have fallen and aeons have passed.

Heading home from the supermarket, we broke down on a roundabout trying to reach home after a series of dashboard warnings. Fortunately, we were only about 200 metres away. This caused some considerable delay, stopping all the local traffic, including one bus driver who was particularly vexed. Calling the AA, we took it to the nearest garage, where a new alternator was fitted, for the price of a pint of petrol...

We visited Penistone market to see the market barn. A wonderful example of contemporary wooden building, commissioned by Barnsley Council in 1980. I thunk and thunk again to find a reason for printing a photo but inspiration, divine or profane, was lacking, and then – 'but



Penistone market barn.

soft, what light through yonder lens doth break?' - full size modelling, in oak, just crying out for reproduction as a townscape or diorama. Honour is satisfied (photo 1).

In M.E.4690 I referred to Stan Shaw, cutler of this parish, and his humble workshop at Sheffield's Kelham Island museum. When visiting the museum recently, for a symposium on steam turbines, I took the opportunity to photograph the workshop itself. From this unprepossessing bench, he manufactured knives of stunning quality (photo 2).

My locomotive *Deborah* now moves under its own self-contained battery and

electronics, emerging from the garage like a snail after an earthquake or a pellet from a GAT. Now to tidy up the wiring, fasten everything down and extend the speed control, on/off and reversing switch wiring to the driving trailer. Also, install fishplates and sleepers to give proper support where needed. A video should be available by now.

In this issue: no GDSF? a badge auction, explosions, two 90th 'birthdays', haulage on a whim and SheSheds.

Raising Steam, from the **Steam Apprentice Club** of the National Traction Engine Trust says that the Great Dorset Steam Fair went very well and the Steam Apprentice Members could take VIP tours including inside the victory organ, plus a steam powered gramophone, according to editor, Jim Huntley. The separate SAC 'playpen' was constantly busy. However, this was tempered by the announcement that GDSF 23 will not take place due to rising costs. Chris and Laura were married and taken to the service by - what else? - their traction engine. 'Unusual engines' continues with the 1929 Fowler Cable Motor ploughing engine, of which only three sets survive. Number 17621 and its partner are the only ones with their original petrol engines.

W. www.ntet.co.uk/sac



Stan Shaw's workbench, Kelham Island Museum.

Chesterfield & District Model Engineering Society is celebrating its 90th year and in the latest, specially enlarged edition of *Stephenson Link*, Terry Leverett was 'commissioned' to record the occasion in pictures. And there was cake! This magnificent offering made the front page and editor John Walker notes that full colour was introduced to the newsletter in 1994 (with a monochrome picture of a 'Black Five'...). An interesting idea was for individually numbered 90th Anniversary badges, £2 each, limited to 300, to match your membership number. The '1' and '300' to be auctioned as a pair for club funds next year. Sadly, several members have died since the last newsletter was published and obituaries by other members record their passing. Vaughn Ayres points out that there are now 18 separate, parallel tracks in the station, shed and turntable area. Pete Nixon describes his wooden driving truck, based on a 1900s-style five-plank, LMS railway wagon.

W. www.cdmes.co.uk

Bradford Model Engineering Society's monthly bulletin for October reports that the latest public running day attracted 11 visiting locomotives, including a five inch gauge Shay, not often seen in model form. On 5 October (surely a month early...) Ian Mckay spoke about explosives. Well qualified in his subject, he began with gunpowder, going on to dynamite and nitroglycerine. This last is very unstable in its raw form - process operatives were given a one-legged stool, to stop them relaxing at their work and causing an explosion. David Jackson, in road vehicle news, visited Otley Transport Extravaganza, spotting a Morris Traveller, NSU Prinz and 1937 BSA Scout, a front wheel drive three-wheel car, now very rare, as only about 300 were made. From the front, it resembles the contemporary MGs. Gas jet numbers are available in three forms, British, US and metric.

Metric is measured in 100ths of a mm diameter, British (BA) in cc/min (fuel flow rate) and US by the Morse drill number used to make it.

W. www.bradfordmes.uk

Leeds Lines, November, from **Leeds Society of Model & Experimental Engineers** has an enjoyable piece by Alan Macdonald on how he turned an unpromising lump of bronze into a twin cylinder horizontal engine. Alan claims to be innumerate but managed to 'see' and reveal the inner shape of the cylinders, eccentrics and valves by removing that material that wasn't part of his vision, using tap wrenches in lieu of a flywheel, and persuading both halves of the machine to turn the crankshaft the same way at the same time.

W. www.leedsmodelengineers.org.uk

Graham Copley of **Ottawa Valley Live Steam and Model Engineers** reports an excellent Hallowe'en run day, during which the diesel ran continuously, carrying 458 passengers in total. Only steam was missing!

W. www.ovlsme.com

Whistlestop, September, from **Hereford Society of Model Engineers**, reports that, for unforeseen reasons, the world and his wife visited the Broomy Hill track on 7th May and cars were parked up hill and down dale. The members expecting a normal Sunday coped magnificently says chairman Wally Sykes. Founder member Peter Fenn celebrated his 90th birthday at the club site, with the other members also in on the fun. Peter wrote an article on his part in the founding of HSME in 1958. Finding that there was no model engineering club in Hereford, Pete was advised, in those three little words which laid the basis for what there is now, 'so start one...' The summer 'Steam Up' produced a fine crop of engines, from the magnificent GWR Armstrong, to the unusual, a Deutch trench locomotive (photos 3 and 4), plus a mobile fair organ built on the back of a Mercedes lorry, by John James. Chris Rayward considers the



GWR Armstrong at Hereford (picture courtesy of Martin Burgess).



Deutch locomotive as above (picture courtesy of Martin Burgess).

blast pipe and steam chest of his L&NWR 0-8-2T.

W. www.hsme.co.uk

Blast Pipe, November, from **Hutt Valley and Maidstone Model Engineering Societies**, bears the news that editor Stephen Sandford has too many calls on his time and is relinquishing his post. A detailed article gave information for the exhibitors at Railex to note and how they should abide by the briefings, minimise congestion and park unobtrusively to avoid problems in the restricted space.

W. www.hvmes.com

Sheffield Society of Model & Experimental Engineers reminds us that their latest talk is now on youtube, about restoring an O&K NG locomotive, by Mathew Dolby. www.youtube.com/watch?v=XCdijlhM8NQ

W. www.sheffieldmodelengineers.com

Steam Lines, November/December, from **Northern**

Districts Model Engineering Society, Perth reports that there was good weather for the Dwellingup and Hotham Valley steam rallies and Ron Collins writes on threads, taps and dies. In 'not for the faint-hearted', Laurie Morgan built a Deltic and, after an introductory paragraph, told a tale of woe concerning a supplier who took his money then ignored his queries, delivered the goods incomplete, with wrong or missing parts, gave a wrong tracking number and lacking dimensioned drawings! Bill Wall continued his Marshall rebuild. At the Hotham Valley event Tom Hardy showed his two-inch scale steam 'whim'. This was a huge machine, weighing 30 tons loaded with 10 foot driving wheels, for use on logging roads, carrying a great log underneath. See www.youtube.com/watch?v=ZlnHOfCRpp8 (photo 5).

W. www.ndmes.org.au



Tom Hardy's steam whim (picture courtesy of Steve Reeves).

Shoulder to Shoulder, from the UK Men's Sheds Association, calls the faithful to ShedFest 2 (the northern one) on November 12th at the Great Yorkshire Showground, in Harrogate - too late for this column. UKMSA will have a stand, assisted by Ripon Men's Shed. Axminster Community Shed has won an award for their 'outstanding' community work, all the more praiseworthy as the Shed is only a few months old. Westhill MS in Aberdeenshire has opened a 'warm place' for a few hours each week, where those who cannot afford heating, or warm drinks, can spend some time away from their problems or discuss them with others and seek advice. I recall investigating a proposed Sheffield Men's Shed some time ago but nothing seems to have happened, so I went looking. For the fourth largest city in England, surprisingly Sheffield has no Shed. (Please don't look at me, I already have lots to do - Geoff.) I also discovered SheSheds, a rather different look at the garden shed. Forget 'man caves', these are luxurious and feminine havens of peace and quiet, according to a Scarborough-front-based female vendor of such garden accommodation.

W. www.menssheds.org.uk

In *Reading Society of Model Engineers' The Prospectus*, for November, David and Lily Scott wrote about their three-days' volunteering at the Bluebell Railway and editor John Billard expressed his pleasant surprise on being elected president. He has read *Model Engineer* since the 1950s (one of the subscribers lived on his paper round...)

W. www.rsme.prospectparkrailway.wordpress.com

Ryedale Society of Model Engineers October newsletter promises a Night Run in which tail lights are mandatory but headlights optional, as they tend to blind oncoming drivers. Much has been the track maintenance therein, including replacing the Down 22 points, which are very old and well

worn. Plain track has been installed awaiting the points being refurbished, including new sleepers.

W. www.rsme.org.uk

Inside Motion, November, from **Tyneside Society of Model & Experimental Engineering**, contains a short piece by Keith Pardey about his LNER V1, providing several well-posed pictures of the rolling chassis, motion and trial assembly. Just the sort of article the editor, Mike Maguire is looking for. Now if YOU did something similar...? Mick Jordison is building a Cockerill VB Type 4 tram engine. Written up in the same style, showing many photographs of before and after major items were added. Have a go, make his day! As a fitting finale here is the well-captioned photo of Roundhouse *Hercules* and its train, aptly situated in the newsletter (photo 6).

W. www.tsme.co.uk

GMES News, November, from **Guildford Model Engineering Society** reports that the test track has been restored, after being started in 2019. It offers three gauges, 2½, 3½ and 5 inch, for members to test their locomotives, needing just a short run (so they don't run out of 'puff'... - Geoff) The Society has been given the contents of several workshops, the sale of items from which has raised over £6,000 so far this year. Matthew Clark writes on the reappearance of the points indicators, otherwise known as ground signals. They are not under the control of the signal box and do not convey any authority to pass them.

Amongst the Bits & Pieces, Tony Hills is adding details to his Hymek, owned for several years. These will include sandboxes, fuel tanks and cab steps. Ian Carney is struggling with his *Fury*. Designed and drawn by the first Martin Evans, there are several inaccuracies and some of the pipework is not possible in the real world. Martin did admit that he never built most of his creations. Bill Read and others went to the Midlands Model Engineering Exhibition, and were pleased to see the 5 inch gauge 'Schools' Class *Epsom*, winner of the top prize. From the picture in the newsletter, it looks very smart indeed. Bill's eye was drawn to the incomplete (as yet) four cylinder, 0-10-0 LMS *Big Bertha*, originally built for the Lickey incline at Bromsgrove. Unfortunately, after returning home, four members became ill with Covid, thankfully not so serious as it once was. Peter Wardropper, a contestant in **Guildford LEC** stopped during a run to wipe down his 2-6-2 *Betty*. There's confidence! He also recorded the longest run, at over 18,000 feet. (This newsletter contained more of interest than many larger publications. Well done! - Geoff)

W. www.gmes.org.uk

And finally... 'When I wrote this computer code, only God and I knew how it worked. Now, only God knows.'

CONTACT

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Last train 'til spring '23 (picture courtesy of Michael Maguire).

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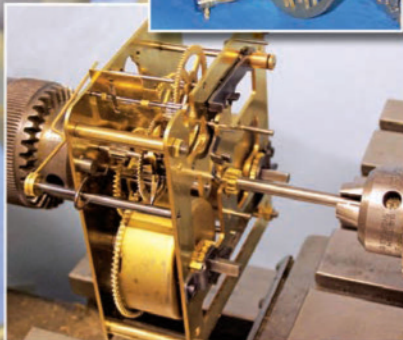
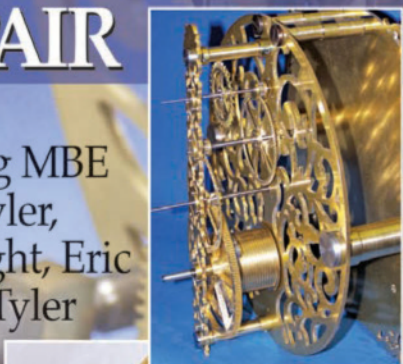
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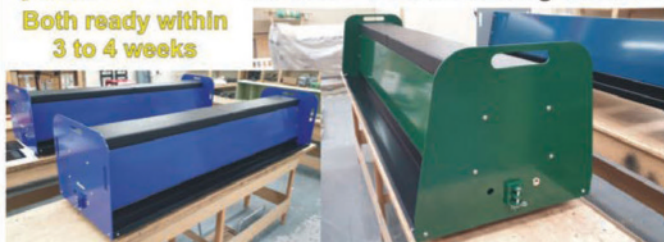


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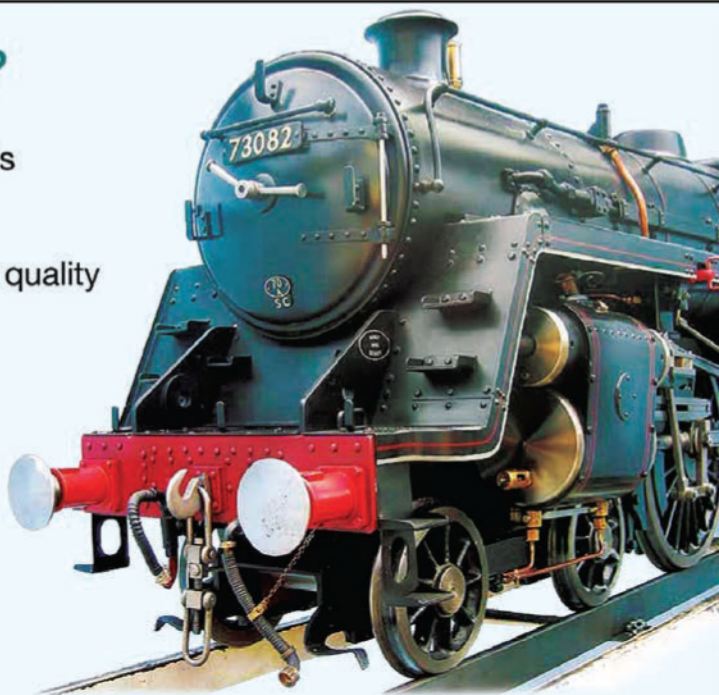
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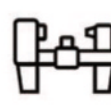
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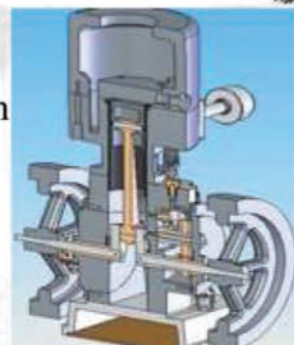
All equipment considered: Myford, Warco, Chester, classic British brands etc
Polly steam locomotives also purchased, especially those needing a bit of 'TLC'

The Junior

Castings and drawings for
home machining



Our Junior model takes its inspiration from the well known Lister Model A. The model runs on the 4 stroke Otto cycle using a glow plug for ignition but can be converted to spark ignition if desired.



8 Castings
brass & steel
material pack
inc. 3 profiles



The drawings are supplied in a book format, each component is printed on one A4 page, there are exploded diagrams, section views and parts lists to help make construction easier to understand

**January
offer £299**

Ex works

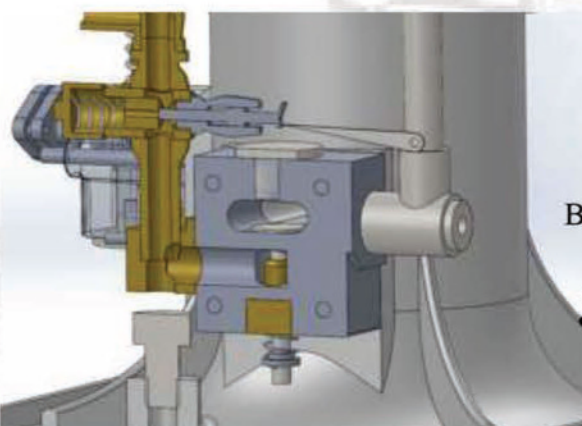
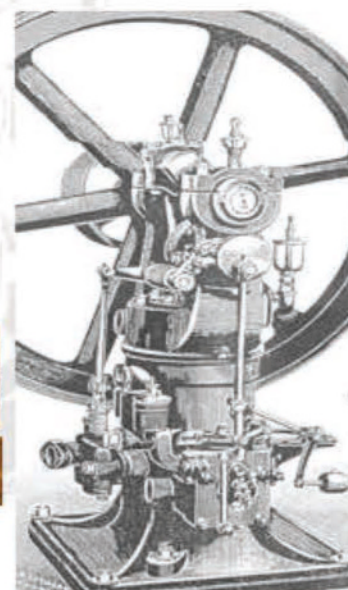
A copy of a reprinted Lister hand book published by
Internal Fire Museum will be included for **free**.

The Otto

Supplied as 8 raw castings, 2 pre cut gears, some raw material, a glow plug and 3 profiles. The Otto inverted D6 engine will build into an impressive model approximately 266 mm tall with a 199 mm diameter cast iron flywheel. The drawings are in book format with a single page per part, parts lists and exploded diagrams with some guidance notes.

Brass nameplates (2) now available
£49.50 inc UK P & P

**January
offer £375.00** Ex works
Inc. name plates.



Hubbard



An interesting 2 stroke marine engine these castings will build into a model of a two stroke marine boat engine based on the 1912 Hubbard engine. The model is run on glow fuel with ignition by glow plug. It has a capacity of approximately 12cc. The flywheel is iron, the remaining castings are in aluminium.

The drawings are traditional format with various views on the same sheet. There are 8 sheets of drawings. Approximately 150 mm tall. 86 mm diameter flywheel. This is an ideal model for those with smaller machinery.



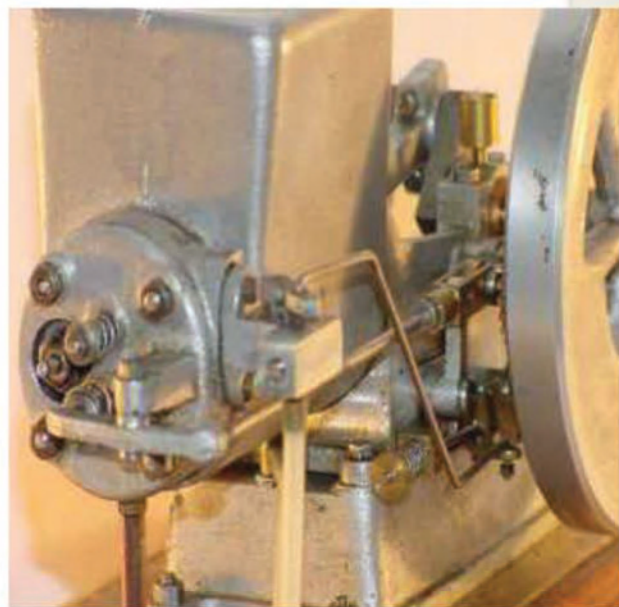
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The Little Wonder

Open crank petrol engine

Castings and drawings

12 raw castings for home machining. Traditional paper drawings. Flywheel 4.25" diameter. An ideal size for the smaller workshop.

Now available in Iron with twin flywheels.

This is a throttle governed engine designed to run on a glow plug but can be converted to spark ignition.

£289. UK post £16.50



The Senior

Full size model open crank engine

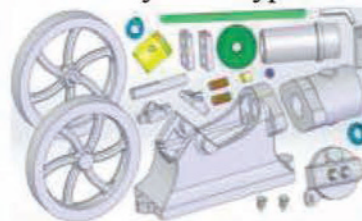
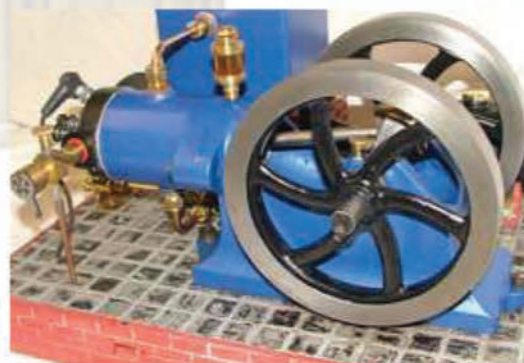
The standard set features £425 ex works

UK post £16.50

- Twin cast iron flywheels
- Tank cooled cylinder
- Automatic inlet valve
- Spark ignition
- Drawings in book form
- 7 castings
- Piston material
- Liner material
- **Offer** includes :-

- Std castings/material.
- Plus extras inc.
- Cam bearing
- Cut gears (2)
- Piston rings (2)
- Valve springs (2)
- Cam profile
- Spark plug
- Oil cups (2)
- Crank material
- Push rod material
- Rocker arm

An ideal model for those with Myford 7 type lathe. The easy manageable parts each provide an individual project building into a compact but usable engine.



Open crank hit and miss petrol engine.

Fully functional 1/4 scale model runs on petrol with a working hit and miss governor.

This comprehensive kit of parts* includes

9 bronze castings,
13 grey iron castings, inc SG Crank shaft,
pre cut timing gears,
bushes, small fixings*,
springs, name plate,
piston rings, spark plug,
piston material.



Ex works £ 625

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* additional parts required
** A detailed construction book is available as a extra

A3 paper drawings and construction notes in booklet form**.

Catalogue available (free)
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Order in the name and livery of your choice



The LNER A3

The world famous "Flying Scotsman" is probably the name that most readily comes to mind out of the 78 A3's that saw service on Britain's railways.

All locomotives received double chimneys by 1960 and subsequently most were fitted with German style "trough" smoke deflectors following complaints from drivers in respect to poor visibility. 4472 was the first steam locomotive to be officially recorded at 100 mph.



Also available with double chimney and smoke deflectors, in the livery of your choice.

The A3's saw service over most parts of the LNER system. The final locomotive, 60052 was withdrawn in 1966. Before the war the A3's were painted in LNER green livery, but carried unlined black 1939-45. They were re-painted in LNER green following the war. A majority of locomotives then carried BR blue livery before all were re-painted in BR brunswick green with orange/black lining. Early, or later, lion crests were carried according to period.

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The Model

This coal-fired model features three cylinders and outside Walschaerts valve gear. The copper boiler is silver soldered and hydraulically tested to twice working pressure, CE and UKCA marked. The body casing is assembled using etched brass sheet.

This development of this model has been supervised by our award winning professional engineer Mike Pavie and the batch is being built by the same manufacturer who supplied our much acclaimed Coronation Class locomotive.

The A3 Class model is supplied fully built and ready-to-run, painted and lined in either LNER green, or BR lined green. We will supply your choice of nameplate. As testament to our confidence in the quality of this model each locomotive will be supplied with a full 12 months warranty. All models will be subject to a pre-delivery inspection and boiler test. Our after sales service is considered by customers to be second-to-none.

Summary Specification

- Coal-fired live steam
 - Silver soldered copper boiler
 - Reverser
 - Working drain cocks
 - Stainless steel motion
 - Safety valves
 - 3 cylinders
 - Boiler feed by axle pump, injector, hand pump
 - Bronze cylinders with stainless steel pistons and valves
 - Sprung axle boxes with needle roller bearings
 - Piston valves
 - Mechanical lubricator
 - Outside Walschaerts valve gear
 - Multi-element superheater
 - Etched brass bodywork
 - Choice of liveries
 - Choice of nameplate
 - Fully painted and lined
 - Ready-to-run
- Approx Dimensions:
- Length 74"
 - Width 9.5"
 - Height 14"
 - Weight 105 kg

£14,995.00
+ p&p

Limited Availability

We have reserved factory capacity for the manufacture of just 25 models. We may be able to increase this a little, but cannot guarantee additional stock availability. Once the batch is completed it is unlikely we will commission further production of the A3 Class for a number of years, if at all. The model is scheduled to complete its build in April 2023.

Free p&p worth £195.00 if you order early.

We will offer free p&p on any order placed within 28 days as a thank you for your early order.

Delivery and Payment

The order book is now open and you can reserve your model now for a deposit of just £1,995.00. We will request an interim payment of £5,000 in January 2023 as the build of your model progresses, a further stage payment of £5,000 in March 2023 and a final payment of £3,000 on build completion.



Please send, without obligation, my free 5" gauge "A3 Class" brochure.

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Address: _____

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