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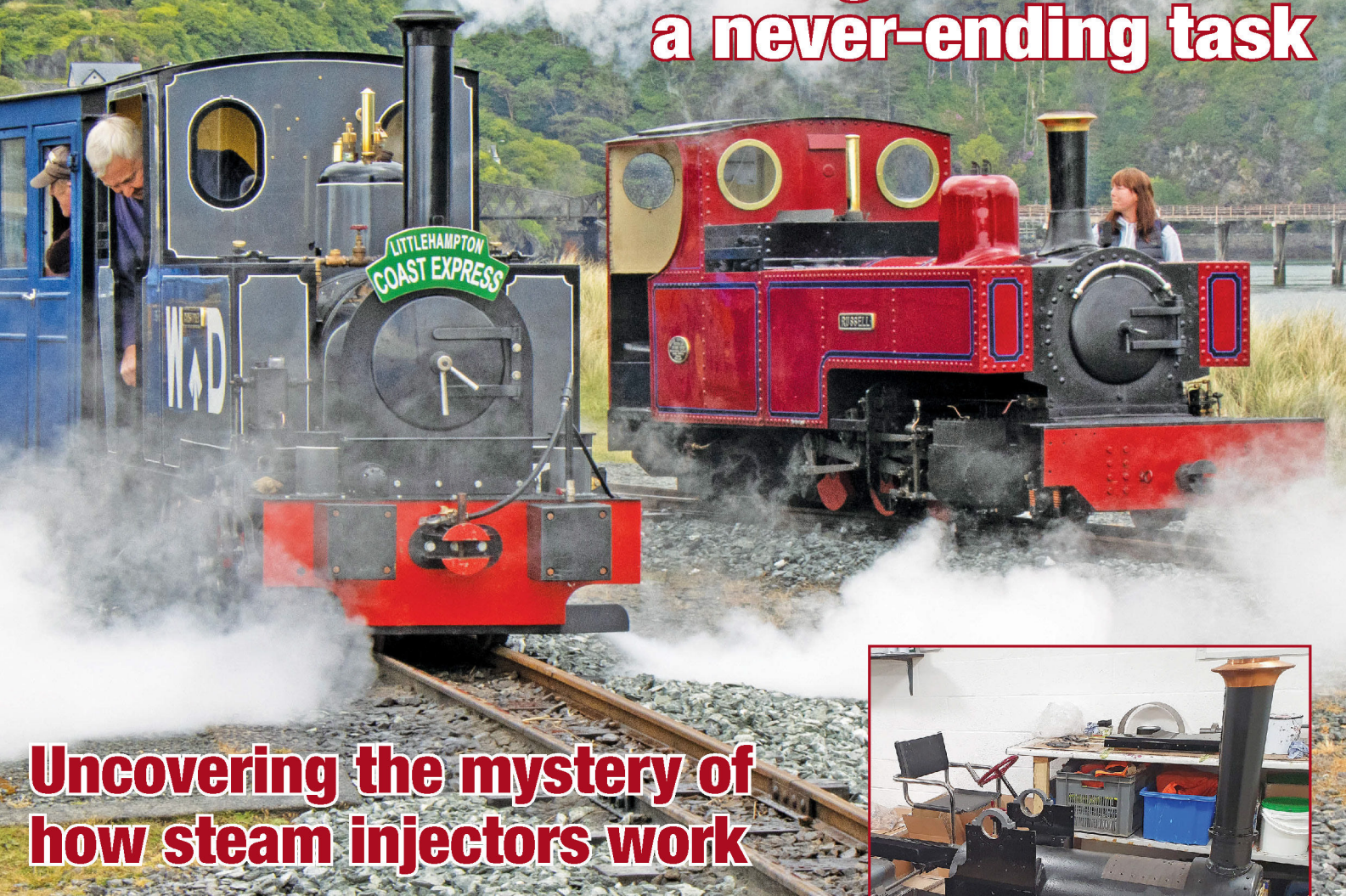
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ENGINEERING in Miniature



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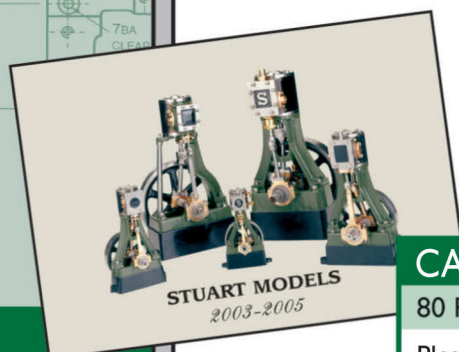


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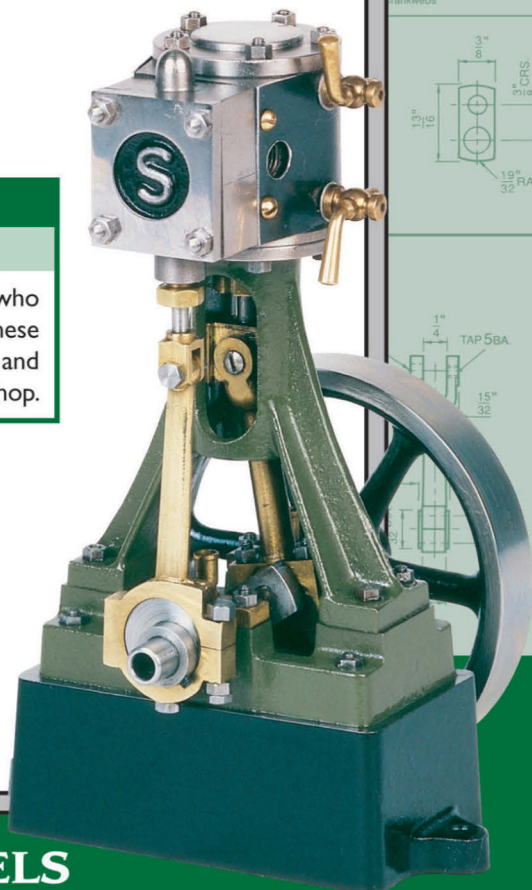
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ENGINEERING
in Miniature



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EDITORIAL

Daddy, where have all the trains gone to?

Welcome to the February edition of **EIM** and you will likely be reading this in the middle of January with equally likely the rain beating on the window and thoughts of driving a steam loco round a track or along a road seemingly very far away – isn't the first month of the year a grim one! Well spare a thought for your editor, who was launched straight into the production of this issue on the day after Boxing Day, just as various offspring started heading to their homes after the Festive excesses – the magazine goes to press, and I prepare to take just a couple of days off, just as everyone goes back to work at the start of the new year!

I'm not after sympathy, honest! But the holiday days for family members after Christmas did produce something of interest and relevance to **EIM**, as within days son James was sending me pictures from a day out to the local zoo they had taken our grandson on following their return to Sussex. The pictures showed a trackbed where on their previous visit had been the rails of the zoo's miniature railway, James describing how difficult it is to explain to an almost tearful three-year old why the trains aren't there any more. I talk about this more in this month's *Club & Track News* pages, but it's not just mature enthusiasts that can be upset by the demise of railways!

So have we set ourselves any New Year's resolutions? I've tended to not be at all good in keeping to such resolutions in the past, especially when they involved spending more time in the workshop! Sadly my workshop is still marooned behind what seems to be even more rubbish deposited by my children in our garage – I will definitely be getting rid of it all this year, won't I? At least, I thought, I could make a couple of early-year trips to help Harry in the Fairbourne Railway workshop, only to find it's having its roof replaced, and until that's completed there's no work can be done. Ho hum...

So how about setting yourself some New Year's resolutions you can fulfil? You know what's coming next – write something for **EIM**! I have a budget that I'd like to be spending on some new contributors (plus the old ones of course!). So if you have a special winter project underway, have had an odd incident at the track, built yourself something new such as a model boat, or a clock, or anything basically any subject that might interest your fellow readers, we are waiting to hear from you! Enjoy your **EIM**. **Andrew Charman – Editor**



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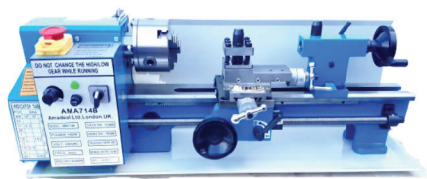
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Engineering in Miniature – ISSN 0955 7644

FRONT COVER

Miniature steam locos require continual maintenance and present constant surprises no matter what their size, as Harry Billmore relates in this issue. Photo taken at the Fairbourne Railway Gala and featuring a visitor from Littlehampton, by *Andrew Charman*.

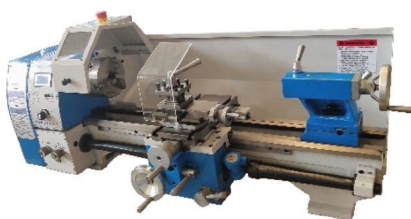


AMA714B Mini lathe
Brushless Motor

SPECIFICATION:

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Taper of spindle bore: MT3
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Number of spindle speeds: Variable
Range of spindle speeds: 100-2250mm
Weight: 43Kg

Price: £694



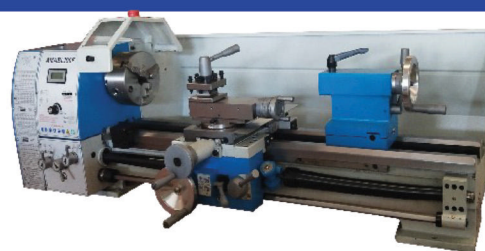
AMABL250Fx750

SPECIFICATION:

Distance between centers: 750mm
Taper of spindle bore: MT4
Spindle bore: 26mm
Number of spindle speeds: Variable
Range of spindle speeds: 50~2500rpm
Weight: 140Kg

Price: £1,904

W 2 Axis DRO - Price: £2,280



AMABL290VF Bench Lathe (11x27) - power cross feed - BRUSHLESS MOTOR

SPECIFICATION:

Distance between centers: 700mm
Taper of spindle bore: MT5
Taper of tailstock quill: MT3
Motor: 1.5kw
Weight: 230Kg

Price: £2,395

W 2 Axis DRO – Price: £2,787



AMAVM25LV

SPECIFICATION:

Model No: AMAVM25LV (MT3) / (R8)
Max. face milling capacity: 63mm
Table size: 700x180mm
T-slot size: 12mm
Weight: 120Kg

Price: £1,360.00

W AXIS POWERFEED - Price: £1,659

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W DRO + PF - Price: £2,045



E3 Mill R8 Metric Brushless Motor

Direct drive spindle.
No gears. No belt

SPECIFICATION:

Max. drilling capacity: 32mm
Max. end milling capacity: 20 mm
Max. face milling capacity: 76mm
Motor: Input- 1.5KW
Packing size: 1050x740x1150mm
Net weight: 240kg

Price: £2,560.00



AMAVM32LV

SPECIFICATION:

Model No: AMAVM32LV (MT3) / (R8)
Max. face milling capacity: 76mm
Table size: 840x210mm
T-slot size: 14mm
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Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

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- Choice of emblems
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- 5" gauge
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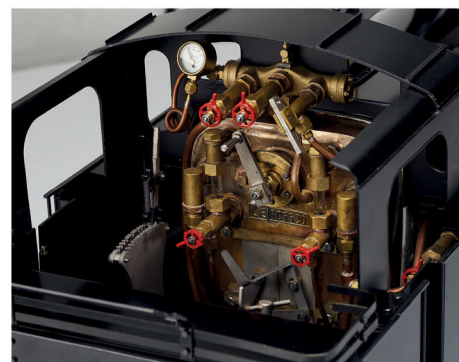
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WILLIAM ROWLAND

An insight into miniature injectors

Roy begins an in-depth study into the characteristics and design requirements of a vital but often misunderstood piece of locomotive equipment.

BY ROY C PRESTON Part One of three

There is an enormous amount of published work on miniature injectors. Having made several of them for my locomotives using published designs, often a key question I have had was “How important are the different dimensions?” and “How does any variation from the published dimensions influence performance?”

To try to address these questions, I decided to undertake a new project that would involve:

- 1) Building a group of six 26 oz/min miniature injectors based on the design given by Derek Brown in his excellent book¹ and a few others according to the very similar design given by Laurie Lawrence²
- 2) Building an experimental test facility to measure injector performance
- 3) Varying dimensions of the injector cones and measuring performance to see how the variations influence the injector performance
- 4) Developing a simple theory of injector performance
- 5) Making a comparison of the theory and experiments.

My project has been published in detail as a digital download, available at this link (<https://bit.ly/3hZDjhZ>).

The basic injector

The basic components of the miniature injector are shown in **Figure 1** and the four cones and body are shown in **Figure 2**.

For those not familiar with the steam injector shown schematically in **Figure 1**, it consists of a coaxial arrangement of a **Steam Cone**, a **Combining Cone** normally in two halves, the first part called the **Draught Tube**, and the second part called the **Forcing Tube**, and a **Delivery Cone**.

Steam at high pressure enters the steam cone and accelerates to produce a small-diameter jet travelling at high speed, emerging from the steam cone into the draught tube of the combining cone. The maximum speed of the steam achievable at the narrowest portion of the steam cone (its throat) is the speed of sound (see later).

After the throat, the steam accelerates along the short divergent part of the cone, and at the exit of the cone the speed will be supersonic. Under these conditions, the steam pressure at the exit of the steam cone will be below atmospheric pressure and it will be capable of drawing water through the narrow annular gap between the outside of the steam cone and the bore of the draught tube.

The steam now condenses in the water as it passes through the two parts of the combining cone, and in so doing heats up the water and accelerates it. It will be shown later that the diameter of the water column decreases and enters the delivery cone which now expands the flow,

RIGHT: Steam and water, the tell-tale signs of an injector about to pick up. Photo: Andrew Charman

FIGURE 1: Diagram showing the components making up a typical miniature injector.

FIGURE 2: The injector body and the four cones.

All illustrations by the author unless stated



decreasing its speed and increasing its pressure (the reverse of what happened in the steam cone).

The pressure generated at the output of the delivery cone is sufficient to exceed the boiler pressure and hence it is possible for the water flow to enter the boiler through a clack valve. The gap between the two halves of the combining cone provides an overflow path via a non-return valve for steam/water to escape whilst the injector is starting up and prevents the partial vacuum in the combining cone being destroyed.

FIGURE 1

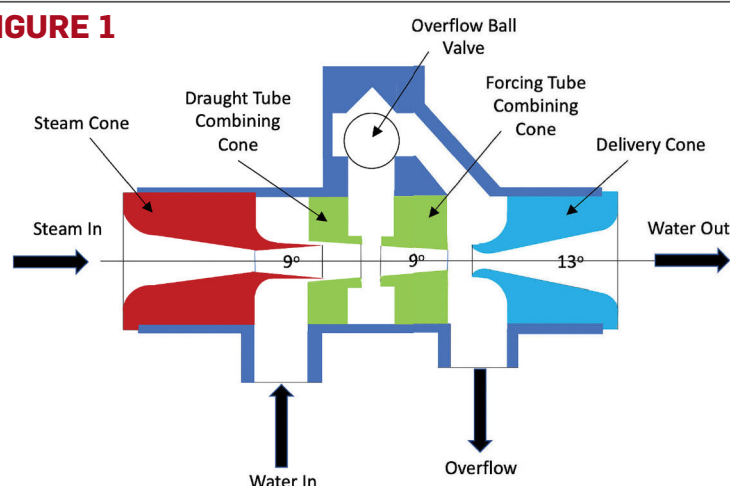
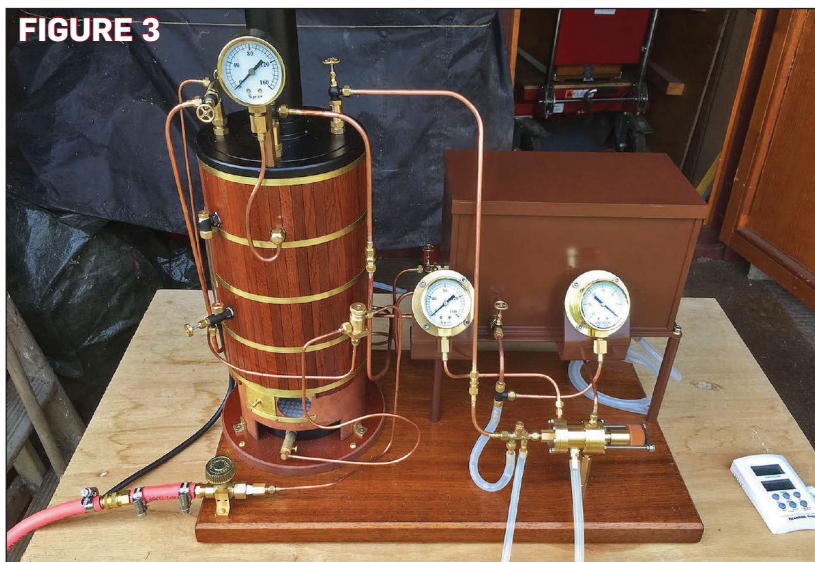


FIGURE 2



FIGURE 3



Injector test facility

In order to determine the performance of injectors, a test rig shown in **Figure 3** was constructed based on the facility originally described by Bill Carter³ and more recently by Derek Brown¹.

The principle of the test is for the injector to deliver the water to atmosphere by using a dummy load,

not letting the water go back into the boiler, so the water flow rate and its temperature can be measured. The dummy load is in the form of a piston which has the boiler pressure applied on one side and the injector output on the other side. Once the injector develops a delivery pressure greater than the boiler pressure, the delivered water escapes and is

FIGURE 3:

Setup of an injector test facility for the experiments in this feature.

FIGURE 4:

Varied injector parameters to be tested.

FIGURE 5:

Delivered water flow rate and temperature rise variations with steam pressure for two pairs of combining cones differing in bore by 0.001-inch.

FIGURE 4

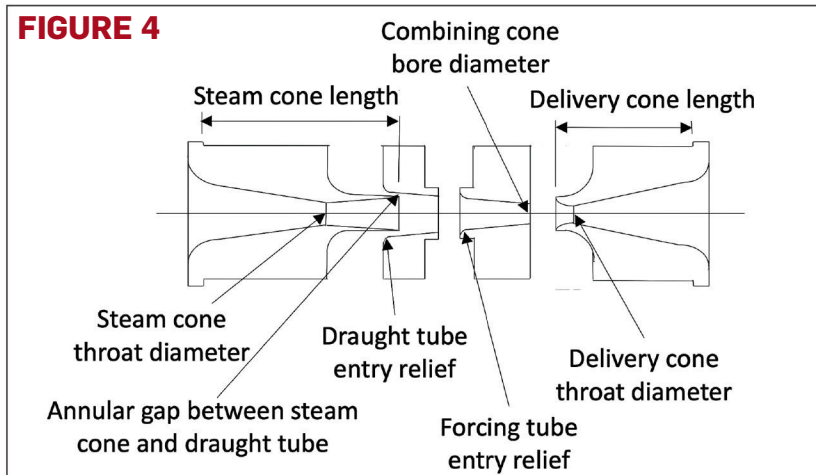
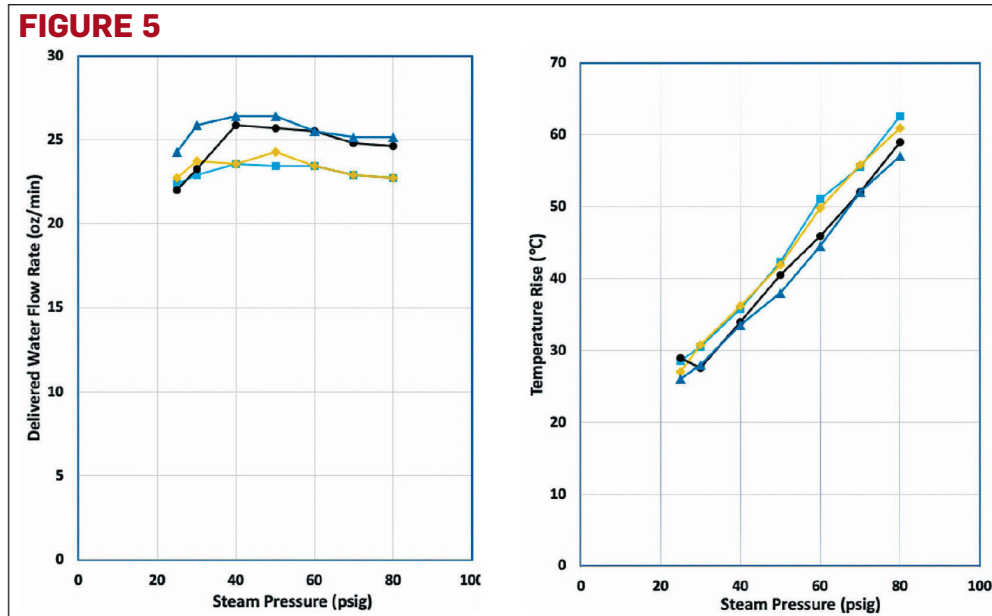


FIGURE 6:

Delivered water flow rate and temperature rise variations with steam pressure for different reliefs (zero to 0.020-inch) at entrance to the draught tube.

FIGURE 5



collected in a container.

The configuration used here also includes the addition of a compression spring plunger to increase the force on the piston, so the actual delivery pressure capability of the injector can be determined.

The parameters that can be measured are;

- 1) Delivered water flow rate
- 2) Delivered water temperature rise
- 3) Steam supply pressure
- 4) Delivered water pressure
- 5) Vacuum level in water supply
- 6) State of the water or the suction at the overflow.

The performance of the injector can be determined over a range of steam pressures. The bulk of the results shown later are for water-flow delivery rates or temperature rises versus steam pressure.

Varied injector parameters

By reference to **Figure 4**, the main parameters varied were:

- 1) Combining cone bore diameter (exit diameter of the forcing tube)
- 2) Combining cone draught tube entry relief
- 3) Combining cone forcing tube entry relief (Linden secret – see later)
- 4) Delivery cone throat diameter
- 5) Delivery cone length
- 6) Steam cone length
- 7) Steam cone throat diameter.

The taper angles for the cones were initially considered something worth changing although all previous work indicated that the angles are not critical. Hence, no investigations were made into the effects of changing these taper angles.

Experimental results

Varying combining cone bore diameter

The diameter of the combining cone bore was increased by a nominal 0.001-inch and results are shown in **Figure 5** for two pairs of cones. The differences in flows caused by the increased bore are about 10 per cent and are a result of the annular gap of about 0.008-inch being increased by about 0.0005-inch, hence an increase of 6 per cent in area and flow. Considering manufacturing diameter uncertainties, this annular area increase is most likely the major explanation for the differences.

For the two larger cone sets, the fall-off in delivered water-flow rate at lower pressures is a direct result of the increased water-flow rate leading to a larger diameter of the water column passing through the combining cone and therefore, not all the water flow is able to pass through the delivery cone throat. The excess water then comes out of the overflow, as seen during the measurements. This behaviour will be

seen in later results and sometimes predicted by theory.

Varying the combining cone draught tube entry relief

The sharp edge at the entrance bore of the taper in a draught tube is usually machined away with a slight rounded relief as shown in Figure 4. Lawrence and Brown give a 0.010-inch relief, there being some uncertainty about how this is specified. To investigate the effect of varying this relief, five draught tubes were made with either no relief or increasing relief depths in 0.005-inch increments up to 0.020-inch. The results for water delivery flow rates, with an expanded scale, and temperature rises for the five different cases are shown in Figure 6.

A small feature observed from these results is that above 40-50 psig (steam pressure) the larger reliefs yield larger flow rates and smaller temperature rises. This is a result of there being less restriction to water flow as the relief depth increases. Apart from this feature, there is no evidence here that the reliefs influence the injector performance. Starting the injector was the same for all entry reliefs.

Combining cone forcing tube entry relief

The relief at the entrance to the forcing tube has always been considered important and is referred to as the Linden secret – for more details see Ewins⁴, Lawrence² and Brown¹. To investigate this relief, five forcing tubes were made with either no relief or increasing relief depths in 0.005-inch increments ranging up to 0.020-inch. The results for water delivery flow rates and temperature rises are shown in Figure 7.

A feature in Figure 7 is the erroneous measurements at two pressures caused by the water-supply valve not being fully opened after starting the injector. Neglecting these two measurements, there seems to be no evidence that the variation in entry relief has any significant effect on the performance of the injectors. As was the case for the draught tube entry relief, starting the injector was the same for all forcing tube entry reliefs.

As for the Linden secret, there can be no comment. For all later measurements, a relief of 0.01-inch depth was used for both the draught and forcing tube entrances, mainly to ensure a smooth entrance with no roughness.

Delivery cone throat diameter

Five delivery cones each with a different throat diameter between 0.029-inch and 0.035-inch (standard dimension being 0.031-inch) were made. The throat position was kept as

FIGURE 6

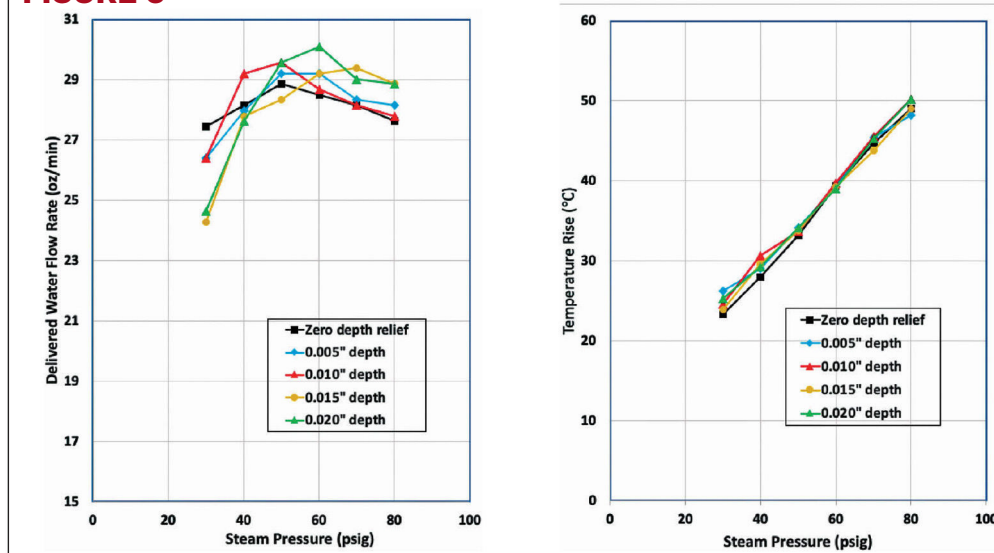


FIGURE 7:

Delivered water flow rate and temperature rise variations with steam pressure for different reliefs (zero to 0.020-inch) at the entrance to the forcing tube.

FIGURE 8:

Delivered water flow rate and temperature rise variations with steam pressure for different delivery cone throat diameters (0.029 to 0.035-inch, standard shown in black).

close as possible to that of the standard design.

Figure 8 shows the results with some variation between cone throats at 30-40 psig, probably related to the water column impinging on the throat, as considered later, but no obvious trends at other pressures. The conclusion is that over the range tested, the diameter of the delivery

cone throat does not influence the injector performance to any significant degree.

Delivery cone length

To achieve different delivery cone lengths, a standard delivery cone was made but 0.005-inch longer, making the throat 0.005-inch closer to the forcing tube. Spacer washers of different thickness were then inserted ►

FIGURE 7

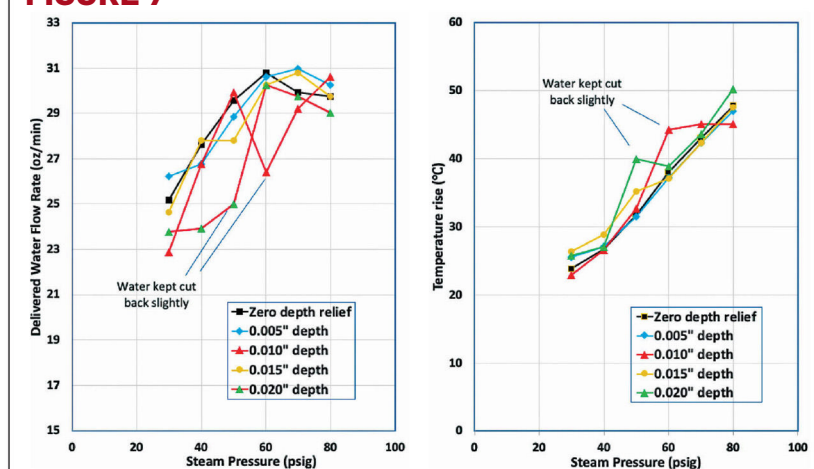


FIGURE 8

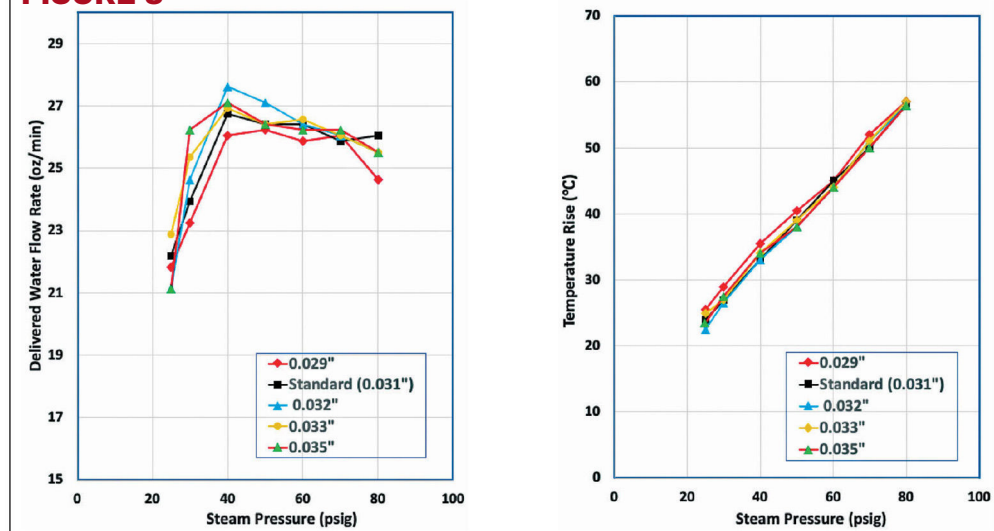
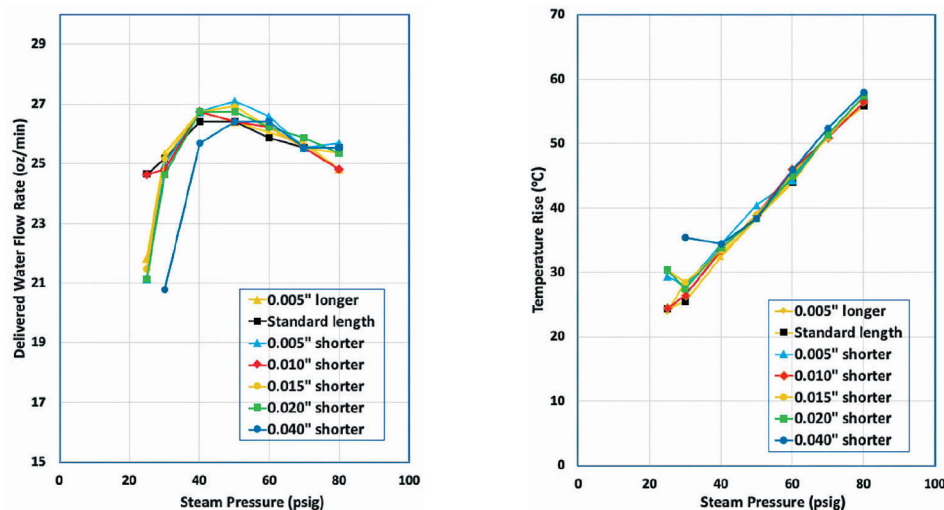


FIGURE 9



between the injector body and delivery cone flange, thereby making the delivery cone length variable from 0.005-inch longer to 0.040-inch shorter than the standard length, a range of 0.045-inch.

The results are shown in Figure 9. At the lowest steam pressures, the three shortest cones show reduced flow, indicating that the diameter of the water column is increasing and less of it is captured by the delivery cone throat. At higher steam pressures there is no systematic difference, indicating that the water column is not impinging on the delivery cone throat, it is completely passing through.

Steam cone length

To enable the effects of different steam cone lengths to be determined, a single steam cone 0.040-inch longer than the standard was made, whilst maintaining the throat at the same distance from the cone tip. Spacer washers were then inserted to enable the cone to be moved away from the entrance to the draught tube in 0.005-inch increments. The results,

shown in Figure 10, exhibit major changes as expected because the annular gap is increasing as the steam cone is moved away from the draught tube entrance.

At the larger annular gaps, shorter cone lengths, the vacuum level registered at the water inlet was at a significant level as the water supply had to be cut back to keep the injector working. Vacuum levels of 10-inch Hg were common at the lowest steam pressures with small amounts of water at the overflow.

As the steam pressure increases, the water supply is no longer restricted and shows low vacuum levels, so the flow rate curves flatten and then further increase in pressure leads to a slow reduction in flow rate because the vacuum at the exit of the steam cone decreases with increase in steam pressure, as will be shown later by theoretical predictions.

The delivered flow rate curves tend to converge towards low steam pressure because of the water supply having to be restricted. At each of the low steam pressures, the bunching of

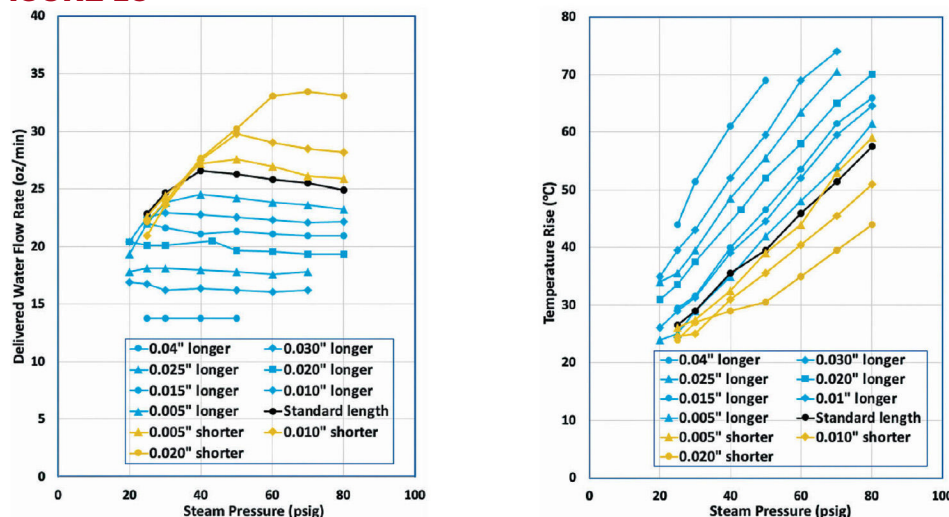
FIGURE 9:

Delivered water flow rate and temperature rise variations with steam pressure for different delivery cone lengths (0.005-inch longer to 0.040-inch shorter than the standard).

FIGURE 10:

Delivered water flow rate and temperature rise variations with steam pressure for different steam cone lengths (0.04-inch longer to 0.02-inch shorter than the standard).

FIGURE 10



these results indicates that there is a maximum water-flow rate at which the injector will work. This will later be seen to be obviously related to the maximum diameter of the water column as it passes through the combining cone and enters the delivery cone.

For the temperature rise curves shown in Figure 10, the longest cones are limited at higher steam pressures by the water becoming too hot and are bunched at low steam pressures because there is less variation in water flow rates.

Note that all plots of temperature rise tend to show high temperature rise limitations at about 70 degrees C. The typical temperature of the water at the inlet was 15 degrees C making the maximum measured delivered water temperature about 85 degrees C. As this will be an underestimate because of losses in collection and measurement, and the potential for additional water heating at the steam cone entrance from the high temperature steam, boiling will occur thereby stopping the injector working.

Steam cone throat diameter

To vary the steam cone throat diameter, a set of six cones, one smaller and four larger than the standard, were made but ensuring the wall thickness of the cone at its tip was 0.002-inch as this is an important feature of the steam cone. This restraint meant that, using the same cone reamers, the throat position would vary slightly. These differences have a small effect on the supersonic velocity of steam at the exit of the steam cone, the exit steam pressure and therefore the water flow, as shown later by the theoretical analysis.

This is one source of variability in the results likely to be obtained here, but another is the uncertainty in manufacture. It is very difficult to create six cones having exactly the same outside diameter of the hollow cone tip when its diameter is only 0.080-inch. Hence, the diameters were measured carefully without damaging the cone tip. These diameters were subsequently used in the theoretical analysis as they change the annular gaps and therefore the predicted water flow rates.

Figure 11 shows the results of the measurements in which four main features are observed:

- 1) The larger the throat diameter, the larger the steam mass flow but the steam velocity at the throat will be the same, the velocity of sound
- 2) The larger the throat diameter, the closer it will be to the end of the steam cone, and this will reduce the level of vacuum at its tip, thereby reducing the flow of water, see the theoretical

analysis later. Figure 11 shows about 5 per cent change in flow rates over the range of throat diameters, the largest throat having the smallest water flow

3) Although the smallest throat will generate the largest water flow, at the output of the steam cone it will have the smallest steam mass flow and smallest steam exit velocity. The diameter of the water column will be larger and at low steam pressure it will be too large to fully pass through the delivery throat. Hence the drop off shown in Figure 11 at low pressures for the smallest throat diameter

4) The largest throats are closest to the tip of the steam cone and they will have the largest steam mass flow rates. They will also have the smallest supersonic exit velocity, least vacuum and smallest water flow. With a lot of steam energy and less water flow, overheating takes place leading to failure as the steam pressure rises and the water temperature is too high, as seen from Figure 11.

Overflow water

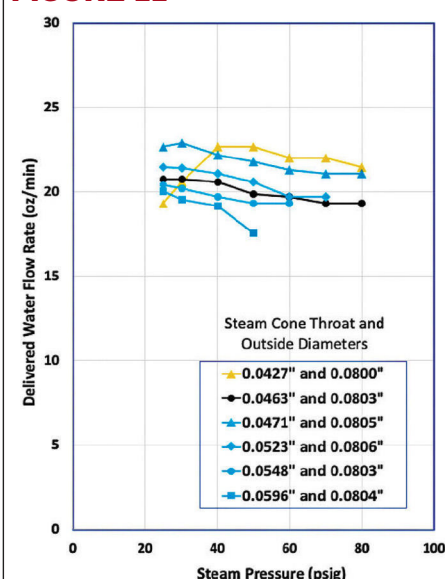
As seen in many of the figures showing water delivery flow rates, there are often drop-offs in delivery rate towards lower pressures. As already mentioned, this is caused by the diameter of the water column being too large for it to enter fully the delivery cone throat. As an interesting exercise, the total water was determined by also measuring the amount of water at the overflow and adding it to the measured water delivery rates. Figure 12 gives an example of such a measurement. Although there is some variation, the total flow rate shows a decrease with increasing pressure, as has been seen at the higher steam pressures in previous plots and will later be seen to be predicted by theory.

Summary of trends

From all the results of measurements, the following is a summary of the trends that have been observed.

- 1) Decrease in steam pressure increases the rate at which water enters the draught tube of the combining cone because, as will be shown later, suction at the annular gap is greatest at low steam pressures
- 2) At low steam pressures, water overflow reduces water delivery rate
- 3) Total water flow, delivered plus overflow, shows a steady decrease with increasing steam pressure
- 4) Relief at the entrance to both parts of the combining cone makes little to no effect on flow rate or starting
- 5) The increase in combining cone bore diameter (forcing and draught tubes) has a small effect on water delivery rate, caused by the increase in annular gap width

FIGURE 11



"It is very difficult to create six cones having exactly the same outside diameter of the hollow cone tip..."

- 6) The steam cone throat diameter has a large effect on temperature rise
- 7) Steam cone length (annular gap variation) will have an even larger effect on water delivery rate and temperature rise
- 8) The delivery cone dimensions are not critical
- 10) As the steam pressure increases, the overflow changes from water flow to suction (vacuum).

As mentioned the subject is studied in more detail in my digital book, see below. **EIM**

■ Next month Roy continues his study, setting up a theoretical model of an injector.

References

Roy's detailed digital book on this subject is available to download from Camden Miniature Steam Services at <https://bit.ly/3hZDjhz>.

- 1) *Miniature Injectors Inside and Out* by D. A. Brown, published 2011 by TEE Publishing Ltd.
- 2) *Laurie's Standard Live Steam Injectors* by D. E. Lawrence, published in *Model Engineer*, 1986 Vol. 156, No. 3774, p370.
- 3) *Testing Injectors* by W. A. Carter, published in *Model Engineer*, 1975 Vol. 141, No. 3519, pp 818-819.
- 4) *The Linden Secret* by J. A. Ewins, published in *Model Engineer*, 2003 Issue 4200, p73.

FIGURE 12

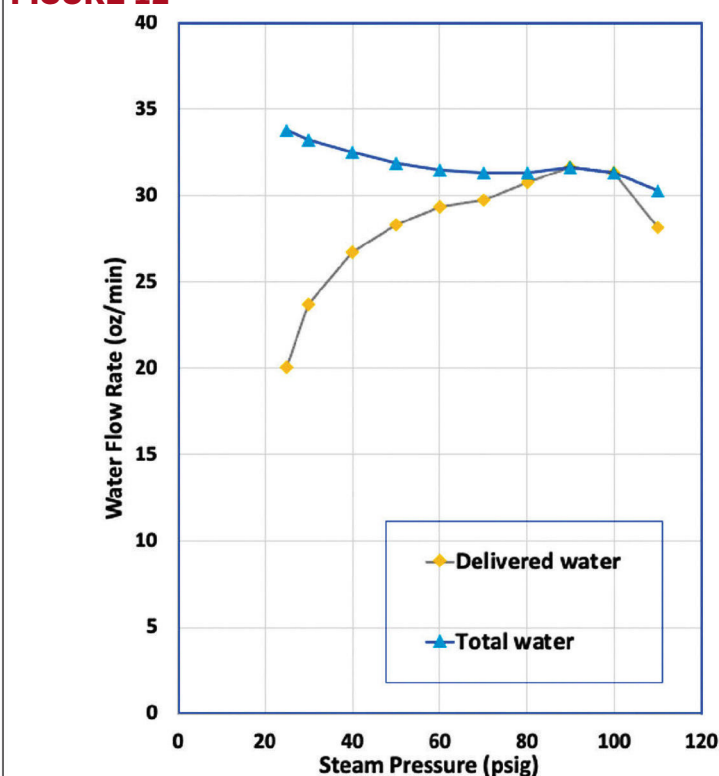


FIGURE 11: Delivered water flow rate and temperature rise variations with steam pressure for different steam cone throat diameters (0.004-inch smaller to 0.013-inch larger than the standard).

FIGURE 12: Comparison of the delivered water flow rate with the total water flow rate as a function of steam pressure.

Building a 6-inch Foden C Type wagon

Peter continues his occasional series, describing the fitting of the boiler and cylinder block to the Steam Traction World kit and his first experience of nickel-plating.

BY PETER MALIM OBE Part Three of an occasional series

In the last part of the series I reached the point of having a rolling chassis, having completed kits 1-10, with the exception of painting the wheels which can wait. I finished just in time to collect the next batch of kits from Steam Traction World (STW) in Daventry – a five-hour round trip from my home in Mid Wales with the trailer. This batch of kits, 11-21, included some chunky and expensive bits including the boiler, cylinder block and crankshaft. Some of the 'kits' are therefore down-payments on the boiler and cylinder block so in terms of hardware there was a slightly smaller pile than the first batch.

The boiler

Photo 14 shows the boiler which is a substantial lump. Made by STW it is all welded steel, has a working pressure of 200psi and comes with a hydraulic pressure test certificate from an independent boiler inspector. The boilers are made to order so the hydraulic test date was just a couple of days before I picked it up. The steel tubes are expanded in so relatively easy to replace in hopefully at least 10 years' time.

There are the usual bosses for water gauge, blowdown and washout plugs, injector and pump feeds. There is also a boss for a fusible plug in the crown of the firebox – STW thoughtfully provides two plugs! The grate and ashpan, which come in a later kit, are attached via four lugs on the bottom of the firebox – these will be fitted with quick-release pins to enable the fire to be quickly dropped if required.

The boiler sides are fitted with blind threaded pads that the hornplates bolt to, and three holes can be seen at the front which align with holes in the front yoke – there are similar holes on the other side. For some reason these holes are through into the boiler cavity which means the front fixing studs have to be sealed against boiler pressure. It would have been better if plates had been welded on the inside of the boiler to make these blind holes. The bracket hanging

down on the front of the firebox is for the attachment of stays which hold the front axle in place – these can be seen in **Photo 15**.

The boiler is fitted to the chassis with four brackets – two each on the front and rear of the hornplates, and the bolts on the yoke already mentioned. Each bracket is made up of two angle irons and a flat plate with multiple bolts holding them together. The rear brackets also have angle irons that support the front of the water tank, so there are a substantial number of bolt holes to line up. STW provides three lengths of bar, internally threaded on the ends, which are the same dimension as the width of the boiler, and this enables the hornplates and backplate to be pre-assembled and installed on the chassis to prove the fit prior to installation of the boiler.

The hornplates have the crankshaft bearing mountings fitted on the top and I opted to have kit 21 – the crankshaft – with this batch of kits so I could assemble it all and check alignment before attempting to fit the heavy and awkward boiler. The instructions warn that holes may have to be elongated, but it is testament to



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PHOTO 14: The Foden's boiler, showing the mounting holes for the hornplates and front axle mount.

PHOTO 15: The boiler installed and test-fitting of the front water tank underway.

PHOTO 16: The gear-change levers with their under-sized guides clearly visible.

PHOTO 17: View of the backplate with nickel plated gear change mechanism and steam manifold.

Photos by the author

the accuracy of CNC machining that they all lined up perfectly. If only all the machining elsewhere on the model was done as accurately...

Once I was happy with all of this I mounted the hornplates and backplate on the boiler. I also fitted the smokebox – again the instructions warned of the likelihood of having to elongate holes for some of the 35 rivet-head bolts that secure the smokebox to the boiler and the front of the smokebox to the barrel, however they all fitted perfectly.

Heavy lift

I don't know what the boiler weighs but it is definitely not a one or even two-man lift. Fortunately I had access to a substantial engine crane, so this was used to safely manoeuvre the boiler into position and fit it with very little drama.

There has apparently been a variation in boiler barrel diameters in the past so two shims, 1mm & 2mm thick, are supplied. It was a matter of lowering the boiler and checking which shims were needed. I used the 2mm thick one to get a good fit. These shims do not have pre-drilled holes for the mounting studs so had to be marked, removed and drilled. Then the front studs could be installed and tightened. A tin of Rocol Steamseal is supplied and if it sticks as well to the steel as it does to skin, it will be excellent!

Also supplied with the backplate kit are the knobs and framework for the gear-change mechanism. As can be seen in **Photo 16** the knobs were too large to go through the brass support frames, so it was necessary to file out the frames and the slots in the

backplate to get them to fit. I subsequently nickel-plated these knobs, as can be seen in **Photo 17** – more about that later. The shaped bar ensures that only one gear at a time can be engaged – it has three speeds with a top speed on the level apparently of about 17mph.

The cylinder block

The Foden has quite a complex engine, being a twin-cylinder compound, with individual cranks and slide valves for each cylinder. The casting is therefore equally complex, with parallel cylinders and outside valve chests with all of the attendant steam passages.

The steam is initially fed into the small-diameter high-pressure cylinder and then exhausted into the larger low-pressure one, so the valve timing is absolutely critical. There is also a spring-loaded valve which, when operated, injects high-pressure steam into the low-pressure cylinder. This is used if the engine stops on Top Dead Centre (TDC) on the high-pressure cylinder, as the low-pressure cylinder will not be at TDC and therefore will start the engine going.

Once going the valve control is released and it shuts again. The engine operates at a working pressure of 200psi and is also quite high revving for a steam engine.

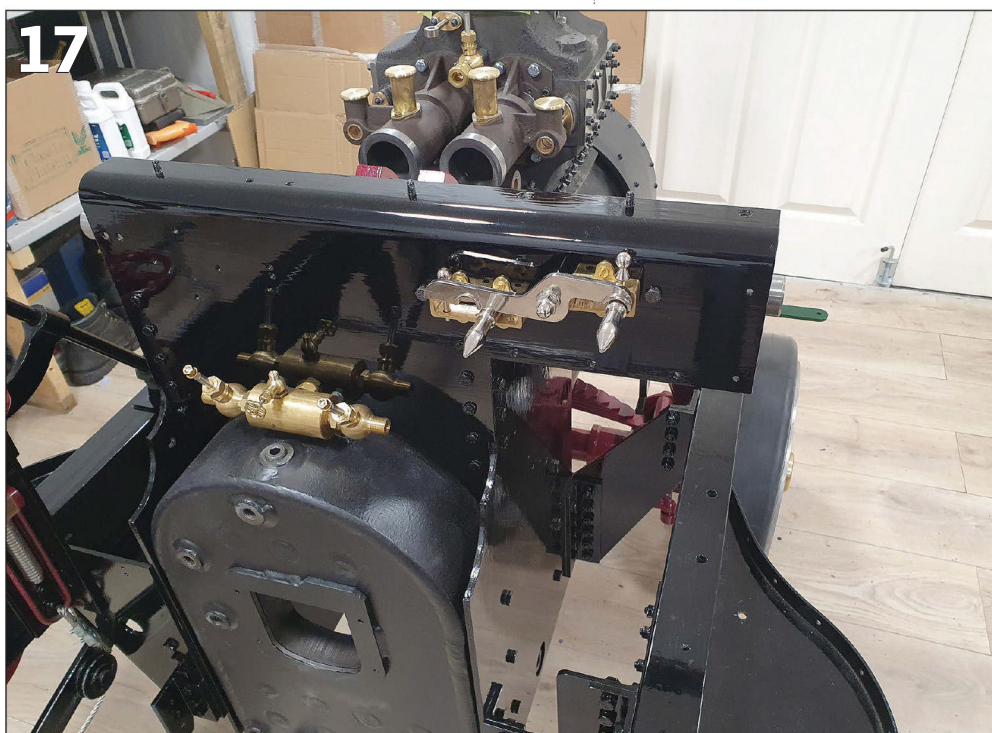
The cylinder block is fully machined ready to install but the casting is quite rough, so the question was how much to clean it up. I decided to do just basic sharp-edge removal as the block is hidden underneath bodywork when finished. I will paint it with the high-temperature smokebox paint primarily for protection.

A plate has to be fitted underneath, the pistons installed and the end caps fitted as these are more difficult to get at once the block is installed on the boiler because of the chimney. I did not have a piston ring compressor but discovered that a heavy-duty cable tie that I had in stock made an excellent alternative – it was wide enough to compress both rings on each piston.

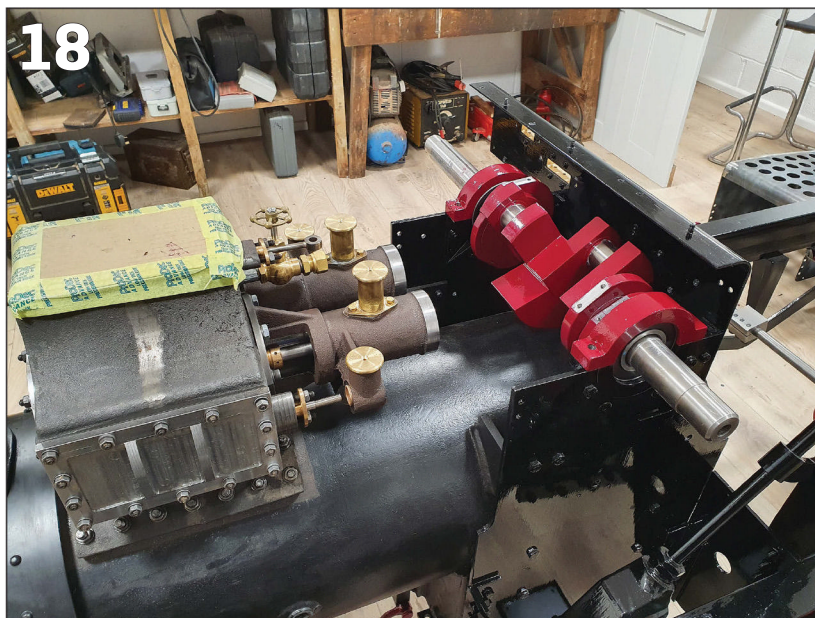
It is possible to fit the trunk guides at this stage but I decided not to do this as the block is quite heavy enough without them and they were easily fitted afterwards.

The next job was to lap-in the slide valves and the regulator block. This is easier to do on the bench before the block is fitted to the boiler, as the block can be set in the best position for each operation. Once lapped-in, the operating rods and gland packing were installed. I fitted the valve chest covers without sealing them, as access is required for setting up the valve timing later on. It seemed worth

17



18



fitting them primarily to keep dirt out. With this done, the block was ready for mounting.

I enlisted the help of a friend as the block is very heavy and, once fitted, a lot of studs have to be installed and tightened before the Steamseal sets. Two gaskets were supplied to take account of variations in boiler diameter. I tried initially with one, but the block was rocking, so both had to be fitted. Having coated the gaskets with sealant we fitted the centre-line studs and lowered the block onto the boiler.

Because of the curvature all of the other 18 studs have to be fitted once the block is in place. The instructions show the order these are to be tightened, and recommends retightening the nuts the following day which I did. **Photo 18** shows the block installed and with the trunk guides fitted. The top plate with the safety valves comes in a later kit, so I put a piece of cardboard on to keep the dirt out of the regulator chamber.

Nickel plating

A number of the Foden's components such as the regulator, steering wheel and gear-change knobs will be subject to wear in use and much of the motion and valve gear is traditionally left as bright metal. I decided to nickel plate these rather than painting or leaving as bare metal, likely to rust. I was concerned about the result being too 'blingy' but having seen other engines where this has been done I decided it would look okay and save a lot of work with wire wool in service.

I did a fair bit of research about nickel plating, which is a relatively simple process compared to chrome plating. The critical points are that cleanliness is essential and that the plating faithfully reproduces any surface imperfections and magnifies them because of the shine, so surface preparation is crucial. The process also uses some pretty nasty chemicals so safety in handling is vital.

I decided to go for a commercial electroplating kit and chose one from

www.eplating.co.uk. I selected the 5-litre kit as this seemed to be big enough for my needs.

Most but not all

The kit contains most things that you need, though only one tub is included – three are needed for the alkaline degreaser, acid etch and plating so I ordered two extra tubs. Once the solutions are made up they can be used repeatedly so tubs with lids are required. All three solutions are corrosive so the kit contains gloves, mask and goggles for safe handling.

The other thing the firm doesn't supply with this kit is an ammeter, which is required to ensure the plating current is matched to the surface area of the items being plated to ensure the correct deposition rate. I bought one on Ebay for £6 and made a small wooden bracket to hold it.

The degreaser, acid etch and plating solutions are made up from the powders supplied – distilled or deionised water is required. Full instructions are provided as the solutions have to be made up and used at different temperatures, with the degreaser working best at 70 degrees C and the plating solution at 32 degrees C. The acid etch is used at room temperature.

The best way to heat the degreaser is to put the tub in a washing-up bowl of hot water. The kit includes a thermostatically controlled fish-tank heater for the plating solution. This takes a long time to heat up five litres from cold, so I put that tub in the hot water to get it up to temperature after which the heater will keep it at the correct temperature. I then used the hot water to heat the degreaser. A digital thermometer is useful for monitoring all this.

PHOTO 18:

Cylinder block and trunk guides installed, and a test-fit of the crankshaft taking place.

PHOTO 19:

The nickel plating setup – wiring still to be tidied!

PHOTO 20:

Nickel-plated items – Peter was not happy with the threads on the bolts so did them again.

PHOTO 21:

Another view of the cylinder block, with the trunk guides and the nickel-plated con rods now installed.

PHOTO 22:

Plenty of work still to do! Kits 22 to 30 wait patiently to be built in a corner of the workshop.

19



20



A ceramic resistor is supplied which goes in the electrical circuit, and I have discovered through experience that this gets really hot in use when plating large items with currents up to 3A – this needs to be mounted on a non-flammable surface! The setup is shown in **Photo 19** – now I have proved the system I will tidy up the wiring from the rather Heath Robinson arrangement.

A ring of copper wire is put around the top of the plating solution tub from which nickel blocks are hung using the supplied titanium wire. This is connected to the positive of the power supply. The items to be plated are hung with copper wire from a structure so they are immersed in the solutions. I have used a plaster corner bead as I had it in stock and it has lots of holes in it to attach the wires to. The negative connection is made to this support structure to make the circuit.

Precise process

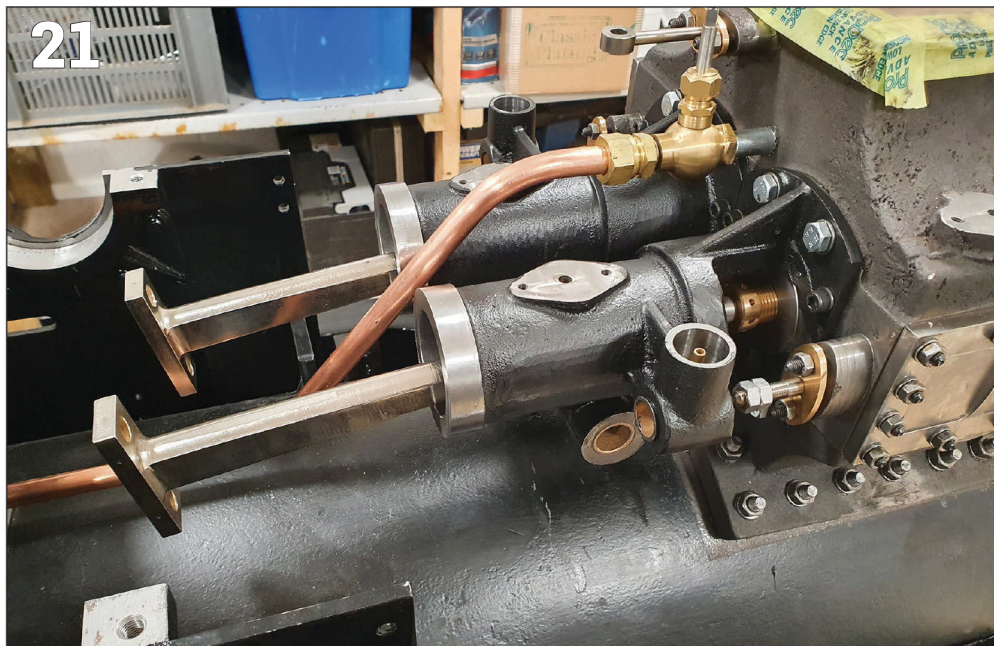
It is important that the items to be plated have been prepared so they are bright metal and as smooth as possible and cleaned up with white spirit. Once the degreaser is up to temperature, the items are lowered in for five minutes, then removed and rinsed before lowering into the acid etch for five minutes. They are then once again rinsed and then straight in to the plating solution – any delay leads to rust appearing.

The setup needs to be near to the rinsing facility – I use my workshop sink – as they will be dripping corrosive liquids. I use another washing-up bowl to transfer the items from solutions to the sink.

The rate of plating is important – too slow and the plating will not adhere properly, and too fast causes a rough finish. The instructions recommend a current of 150mA per square inch of the item to be plated. At this current 25 microns is deposited in 25 minutes, which is the recommended thickness to produce a robust finish.

Photos 20 and 21 show the result. Note that the threads on the bolts are not very well plated. This is due to insufficient preparation and I have subsequently cleaned these up and re-plated them. The finish is not as shiny as chrome, and I think it will suit the situation.

I did find that the circular tub was just not quite big enough to plate the connecting rods. I managed to degrease and acid-etch them in the existing tubs by carefully tipping the tubs to immerse them, but this was not practical with the plating solution. I happened to have a suitable rectangular tub available so I



“Cleanliness is essential – the plating faithfully reproduces any surface imperfections and magnifies them because of the shine...”

transferred the plating solution and nickel blocks to this.

Next steps

I have now completed kits 1-21, with the exception of painting the wheels and preparing and painting the water tanks. As the tanks are welded mild steel, they require lining to prevent corrosion. I have purchased a kit called POR15 which was recommended by STW.

The kit consists of a degreaser, acid etch and a fluid which coats the inside with an impervious layer. This is designed primarily for lining fuel tanks for car and motorbike restoration, so should cope well with treated boiler water. There are two tanks, each of which holds 75 litres, so they are quite large. Swilling these various liquids around in them, with rinsing and drying between each

operation is going to be challenging.

I picked up kits 22-30 recently and **Photo 22** shows the workshop with the large number of stout cardboard boxes piled in the corner and with the body and cab kits sitting on the back of the chassis.

This completes the standard vehicle as a flat bed, but I have chosen to also purchase optional kit 31 which is a back board and drop-down sides for the load bed. This is still being made but I am a fair way away from needing it yet. The next part of this series will describe the build of these final kits. **EIM**

■ The first two parts of this series appeared in the June and October 2022 editions of **EIM** – you can download digital back issues or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature



An improved Schools – building a Roedean

Nick introduces the 3½-inch gauge locomotive project he will describe over the coming months by looking at some prototype inspiration.

BY NICK FEAST Part One of a short series

I'm old enough to remember when no one began a sentence with "So..." and you could pull one tissue out of a box without the whole pack following suit. I can also remember the last year that Maunsell locomotives were a common sight on the Southern Region, which was 1962. Passing the 11-Plus exam in 1961 meant a place at Brockenhurst Grammar School and a classroom with a pretty good view of what is now known as the BML, the Bournemouth Main Line. As train spotters we enjoyed going to school more than most!

At that time electrification was on the distant horizon. We travelled to school on push-pull trains pulled (or pushed) on the Lymington branch by Victorian tank locos that would have been familiar to our grandparents. As well as the relatively modern Bulleid Pacifics and BR Standards it was not unusual to see trains pulled by 'Arthurs', 'Nelsons', S15s, U, N, Q and Q1 classes and of course the V class, which were always known as 'Schools'.

Through trains to Bournemouth from the north were usually hauled by either 'Halls' or 'Granges'. I don't remember seeing a diesel until around 1964, when Cromptons took over some of the freight. They weren't able to take over much passenger work because of the need for steam heating.

In the harsh winter of 1962 all this variety ceased almost overnight and scrap lines at Eastleigh works, just outside Southampton, were soon full of all the old classes. However out of the 40 Maunsell-designed Schools-class locos three were to live on.

All-round performer

The Schools class was really a cut-down version of Maunsell's four-cylinder 'Lord Nelson' 4-6-0, designed to have greater route availability including on the very restricted Hastings line. They were to replace older 4-4-0s such as the L-class on these routes, a type of locomotive that I have modelled quite recently. Whether by luck or design the drawing office at Eastleigh not only produced in the Schools the most powerful 4-4-0

HEADING:

'Repton' on the NYMR. Photo: Chris Bracey

PHOTO 1:

Repton out of use at Eastleigh in 1966 prior to shipping to the USA.

Photo: author's collection, R Fuller

PHOTO 2:

'Stowe' in store at Stewarts Lane in 1963 prior to going to Beaulieu. The AWS battery box and cylinder have been fitted on the running plate ahead of the cab.

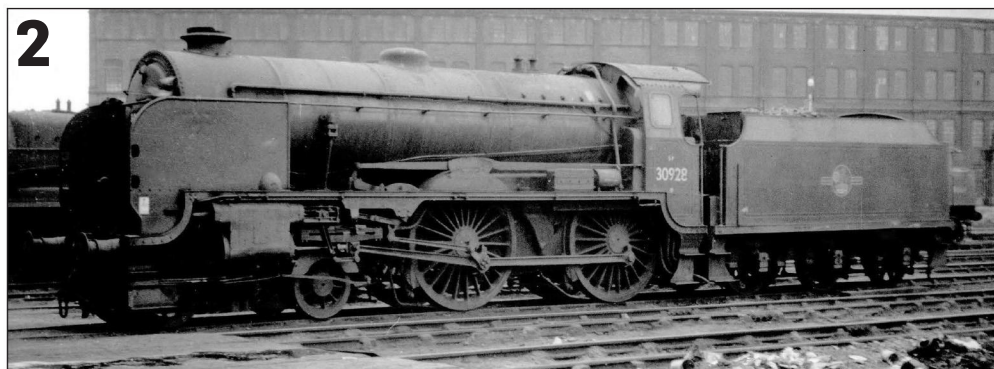
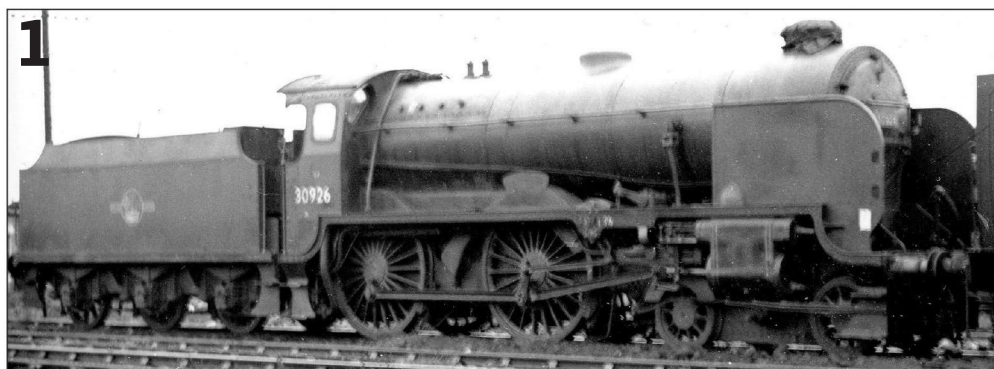
Photo: author's collection, I Goodall



ever to run in Britain but a splendid all-round performer that is still working in preservation today.

Photo 1 shows 30926 'Repton' in storage at Eastleigh with a sack over its chimney, but unlikely ever to operate again for British Railways (BR). After a

cosmetic overhaul at Eastleigh, 30926 went to the USA as an exhibit at Steamtown, Vermont and then on to the Cape Breton Steam Railway in Nova Scotia, Canada. There it received extensions to the tender coal space, which it still carries on the North



**PHOTO 3:**

Stowe on static display with three Pullman carriages at Beaulieu in 1966. Photo: author

PHOTO 4:

Stowe restored to full running order in dark green Southern livery. It ran at the Bluebell railway through the 1980s and is expected to return to traffic next year after an extensive overhaul.

Photo courtesy Bluebell Railway

PHOTO 5:

'Cheltenham' freshly repainted at Ropley on the Mid Hants Railway in 2019. Photo: author

Yorkshire Moors Railway today. The buffers were replaced with buckeye couplers while air brakes, a 'cow catcher' and headlight were also fitted. Repton returned to the UK in 1989 and has since been operating successfully on the NYMR.

Photo 2 shows 30928 'Stowe' at Stewarts Lane shed in Battersea, south London in the early 1960s – the lack of nameplates indicate the locomotive is possibly withdrawn and in storage. There is still plenty of coal in the tender and no sack over the chimney unlike in the previous photo so it could be just in storage.

In 1964 Stowe moved to the Montagu Motor Museum at Beaulieu,

as a static exhibit coupled to three Pullman carriages (**Photo 3**). This was a bit of a misnomer as despite their excellent performance a class 5P is unlikely to ever have been rostered on the Bournemouth Belle, although BR Standard 5s were used in emergencies at the end of steam.

Stowe remained at Beaulieu for nine years but according to the curator at the time, Michael Ware, it was not possible to generate enough revenue from the catering operation within the Pullman cars to cover the increasing maintenance costs. No platform was ever constructed so carriage access via wooden stairs was not ideal. In 1973 the loco moved to the East Somerset Railway and then to the Bluebell in 1980, where it is now nearing completion after overhaul, having worked on the line between 1981 and 1991 (**Photo 4**).

The third survivor of the Schools class is 30925 'Cheltenham', which is in the National Collection and based at the Mid-Hants Railway – the 'Watercress Line' along with her larger Maunsell predecessor 'Lord Nelson'. Cheltenham's boiler ticket expired in 2022; a lengthy period in storage/overhaul is likely to follow. **Photo 5** shows the loco in the yard at Ropley after a repaint into BR livery in 2019.



In full size these engines produced performances beyond what was expected of them, being able to keep to time on 500-ton trains on demanding routes such as Bournemouth to Waterloo expresses. There are no really steep gradients on this route but the 17-mile climb from Eastleigh to Litchfield Box at an average gradient of 1 in 250 requires consistent steaming with no opportunity of a run at the bank. Indicated horsepower of up to 1,250 have been calculated, which is outstanding for a locomotive weighing just 67 tons.

Long search

I have always liked the Schools class and had been looking out for a 3½-inch gauge model to purchase. One had visited our club a few years ago and when I heard that the owner had sadly died I made some enquiries. It seems that it had already been bequeathed and was not available.

Then in October 2019 a part-built 'Roedean', LBSC's Schools design dating from 1948, appeared in the small ads of *Model Engineer* magazine. I contacted the vendor, who did not live too far away, and he was in fact a fellow contributor to this magazine. The asking price was reasonable and the deal was soon done. I had a Schools to build!

Within a few months the pandemic arrived along with the possibility of a lot of extra time in the workshop. The LBSC drawings for an authentic piston-valve version and the detailed building notes were included in the sale, along with a set of drawings for a slide-valve version by Jackson, sold originally by Clarkson's of York dating from around 1935.

The LBSC series was published in *English Mechanics* in 1949/50 and was reprinted without updating in *Model Engineer* in 2011/12. Having built a few locomotives already I combined what I thought were the best elements of each design and added a few of my own, which I will describe in detail in the next articles. **EIM**

REFERENCES: *Great Locomotives of the Southern Railway* by O.S. Nock, published by Patrick Stevens Ltd.

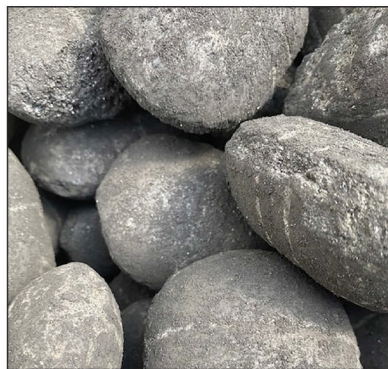
■ **Next Month:** Nick starts his project by analysing what he has bought and what he needs...



Coal of the Future

EIM totally supports efforts to make possible more sustainable miniature steam in future – this month Edward continues his description of the Rugby ME's experiments with new 'green' replacements for locomotive coal.

BY EDWARD PARROTT Part Two of three



Last month in the first part of this short series I described the Rugby ME's largely successful experiments with Ecoal 50, a manufactured sustainable fuel combining biomass with coal. But being the experimenters we are, settling on the first thing we tried that worked wasn't our idea of a really thorough investigation, so we set out to try some more fuels.

For our next trials, we opted to buy four different fuels – Columbian Doubles, Trevithick Welsh Steaming Ovoids (Hargreaves), Wildfire Ovoids (Coal Products Limited), and Scottish coal from the Ayr coal field. Using two online coal merchants, we had half a ton each of the Columbian and Scottish coals delivered, and a quarter-ton each of the processed

fuels. We knew we needed a good supply to make our purchase worthwhile, but didn't want to pour too much money into what were basically unknown fuels.

Two of these, Columbian and Scottish, are lump coal products, one domestic and one imported. Both are subject to changes in the law coming in to force during 2023, and I wouldn't like to bet on either being around for very much longer. The current text from Gov.uk says all sales of traditional house coal will be banned from 1st May 2023 (in England only), and it must be delivered in bulk or open sacks – presumably this last refers to the remaining time left, as another note refers to advising customers from 1st May 2021 that the ban is coming into force.

"We didn't want to pour too much money into what were basically unknown fuels..."

The remaining two fuels are processed – Trevithick is a blend of anthracite fines and lime which is cold-pressed into briquettes, and as it's purely coal (apart from the lime) it is not an 'Eco' coal (**Photo 14**).

Rain-friendly - not

One thing we found – don't get it wet! It's a cold-pressed briquette (as opposed to resin-bound or hot-pressed) as once it gets wet it disintegrates into a slurry, and I found this out by accidentally leaving half a bag out from one weekend to the next, during which time, of course it rained!

Wildfire is a blend of 'coal', petroleum coke and anthracite. Early in the trials at the standard-gauge Keighley & Worth Valley Railway, an issue became apparent with high chlorine content of the CPL products on test, with a green layer deposited on copper fireboxes and a concern of chlorine embrittlement. We have not witnessed this during our tests, and CPL has worked with the heritage railways testing the fuels throughout the year in order to refine the fuels and alleviate any issues like this which could become a problem.

It was originally believed to be a resin binder that held these briquettes together, and it was thought to be this that may have led to the green coating. The latest listing from CPL however lists Wildfire as having a molasses binder just like the Ecoal 50, a bio-product and so not something that concerns me.

The first fuels we opted to try were the Trevithick Welsh Steaming Ovoids, and the Wildfire Ovoids, but in a change to the previous test session we opted to run both Romulus locomotives again, but run one on each fuel, and assume (dangerous!)

ABOVE LEFT:

Shape of things to come? The difference between Welsh steam coal and the more sustainable alternatives now under trial, in this case Ecoal 50. Photos: Andrew Barnes, Bure Valley Railway

PHOTO 14:

One of the latest tried by the author at the Rugby club – Trevithick Welsh Steaming Ovoids.

Photos by the author unless stated



that they would have performed similarly as before.

Much more mixed results have been found with these fuels in full-size locomotives, so we were not sure what to expect. The 15-inch gauge Bure Valley Railway has again been leading the trials (Photo 15-16), along with input from the standard gauge North Yorkshire Moors and Keighley & Worth Valley lines.

The 2ft 3in gauge Talylyn Railway, where I am a Fireman, had ordered a bulk load of Trevithick Ovoids to mix with its remaining Welsh to stretch it out, however a fellow TR volunteer used it for a road-run on his full-size traction engine, and after three miles the fire was completely clinkered over and had to be drawn and replaced. A trial in his home fire later produced an ash content of 29 per cent by weight, but I'm not convinced that that would be true of a forced fire.

Wildfire Ovoids had also been trialled, and one consistent feature that was occurring was the volume of fine ash being produced. This was giving its own problems at the end of the day – the least little bit of wind blows the dust all over the engine and covers it in a very fine ash.

Using water to wash the ash out or dropping it into a wet pit, causes the water to flash off to steam and carry with it the fine ash – you have to remember these fuels (or Wildfire at any rate) were designed to hold heat for a long period of time to keep a household fire warm overnight, and this seems to extend to the ash too.

With the model locos, we followed the same testing process as before. Bunkers were swept out, fires were lit purely on paraffin or diesel-soaked sticks, and the only fuel burnt was the Trevithick (Romulus 'Dr John') and Wildfire (Romulus 'Myglyd'), to make sure there was nothing to skew the test results.

Different scenario

Both fuels took a little getting familiar with, once again assuming that the behaviour would be the same as the Welsh Dry that we were used to was a recipe for disaster. Steam raising was not problematic for either fuel, coming round in the same 30 minutes that we are accustomed to. Once out on the line however, the behaviour was very different.

As with the Ecoal 50, more weight of coal was definitely going through the firehole door than with the Welsh, however it wasn't burning through as much as the Ecoal was. Four laps to a bunker of Welsh was the usual expected (four miles on our track), and where Ecoal 50 had been returning 2½-3 laps, both the

"When steam raising assuming that the behaviour would be the same as the Welsh Dry that we were used to was a recipe for disaster..."

PHOTO 15:

The 15-inch gauge Bure Valley Railway has been at the forefront of future fuel steaming trials on the heritage railway network...

PHOTO 16:

...and has taken a very systematic approach with close monitoring of all aspects of the new fuels' behaviours.

Photos: Andrew Barnes, Bure Valley Railway



Trevithick and Wildfire were returning three to four laps each.

The Trevithick in Dr John definitely took the most getting used to – this was the one giving me most cause for concern after the previously reported tests by our friend with his full-size traction engine and similar reports of clinkering from the railways. We did manage a five-hour running stint, with a lunch break, and didn't suffer to the same degree. It was

very clear though that the fuel was tending to generate more ash, and that ash was sitting on the firebars.

It didn't appear as though the fire was actually reaching the ash fusion temperature, and wasn't forming a lot of clinker – one good point so far! It was however needing fairly regular raking through so the ash wasn't clogging the bars, something which should be avoided normally as it risks distorting and dislodging firebars. ▶





The knock-on effect of this was that the ashpan was filling faster than with any other fuel, as you might expect from regular raking. Later in the year, this was to be a problem with another engine, but more on that later.

Ignition time was slower than would have been expected for an anthracite-based fuel, possibly a damping effect from the binding agent, and although the fuel did stay hot for a long time, it also went cold very quickly, so if you were slow to rebuild the fire you could suddenly find yourself going off the boil very fast indeed.

At around the four-hour mark I found myself struggling with it considerably, and actually did one lap of the track with the blower wound open for three quarters of the circuit, and with boiler pressure stubbornly refusing to rise above 70psi – on a 100psi copper boiler! There's a saying that I like – if there's not enough pressure in the boiler, there's probably too much coal in the bunker! It was

"It also went cold very quickly – if you were slow to rebuild the fire you could suddenly find yourself going off the boil very fast indeed..."

quite obvious at this point though that neither firing it thin or firing it thick was making much of a difference, and it had very definitely gone off the boil.

Reaction time

The Wildfire in Myglyd, however, was faring better. It too takes a little longer to get going than the Welsh Steam Coal, however we found it tended to tail off as it was burning out, so you got some warning, rather than the sudden stop with the Trevithick. This means it reacts in much the same way as Welsh Steam Coal and can be fired in much the same way, although a little more pro-activity is required in order to get the coal alight when it's needed as it is slightly slower to catch.

After a little while we were getting into a routine where firing would be required at certain points of the track to prepare for later sections, and it is noticeable that on the Wildfire fuel you would have to be five or six rail lengths early (Trevithick was easily double that).

Ash sitting on the firebars wasn't as much of a problem from this fuel, something which going forward will be a big consideration. Again, we didn't seem to be getting up to the ash fusion temperature, and so clinker wasn't particularly forming either on the firebars or in the ashpan. Use of the rake was minimal, which is how it should be, and as before it sat nicely over lunch keeping everything hot.

Having put in about another five hours running on each engine, we decided to call it a day, cap the chimneys, and let the fires die while we had tea. Once both fires were dead the remains were pulled and inspected as before.

A reasonable amount of clinker was pulled out from the fire of Dr John, measuring roughly the size of a hand in area, however virtually nothing was pulled from the fire of Myglyd (Photo 17), in this respect the

Wildfire had performed exceptionally.

Once we dropped the fires, the ashpan contents also proved interesting. The Trevithick had left a very fine ash, and we were actually surprised by how little was remaining in the pan, there being some speculation that the ash had actually been exiting the rear of the ashpan via the damper door, drawn out by air currents due to it being so fine, and the tender was covered in it.

Restricted breathing

You can see just how much clinker was present though from the photo (Photo 18) and it's not surprising it went off the boil given that a Romulus grate is only six inches square. A large amount of ash was also deposited all over the engine and the crew, courtesy of a gentle breeze – we really will have to watch the ash with this fuel, otherwise bearings will be wearing out in short order.

The Wildfire was a different story though. Dropping the ashpan on Myglyd revealed a very uniform ash, almost as though it had been graded (Photo 19). No more clinker was found in the ashpan, which is good, and we were left with a pile roughly 1-4mm in size, for 90 per cent of its volume. While sitting and dying out the remaining fuel in the fire had done exactly as would be expected in a typical home fire that had been banked up for the night, but then, that's what Wildfire was always intended for.

There wasn't so much fine dusty ash blowing around when the ashpan was dropped, and from a mechanical point of view this is certainly better for the engine, in terms of less grit to get in to bearings.

Come to the front end, and both engines had similar scenes in the smokebox. On this occasion Dr John was run without a spark arrestor (this was a members' running session again



and no public were on site), but Myglyd did have its fitted. Neither engine was noted to be depositing ash on driver or carriages with these fuels, which is considered to be a bonus for sure. Running through the later part of the year confirmed this was normally the case – working the engine particularly hard could still produce the odd ‘hot one’ or two.

Both smokeboxes were filled with a granular ash, very slightly sticky to the touch, ranging in approximate size from 0.5 to 2mm for five hours’ running. There wasn’t the volume we might have otherwise expected, but in the case of the Trevithick (**Photo 20**) this bears out the amount of ash sitting on the firebars, and in the case of the Wildfire how much better the fuel was burning and how little foreign matter was in it (**Photo 21**).

Size matters

Of the two fuels I think it’s safe to say the Wildfire proved the greater success, by a comfortable margin. The Trevithick had proven to be a handful on the miniature, although I’d had no particular problem with it at the Tallyllyn, and following trials at Rugby later in the year in a Shay and the Garratt ‘Mount Kilimanjaro’, I have come to the conclusion that what it really needs is a bigger mass of fire – the 6-inch square grate of a Romulus just wasn’t big enough for the fuel to burn well.

Both the Shay and the Garratt were able to run for a similar five-hour duration including layover for lunch, without going off the boil, however ash was a problem that was to bite us twice during the year, once in each engine.

It was the Garratt first, on its first outing with the Trevithick – we’d lit the fire at 08.00, taken two hours into steam, then ran from 11.00 to 13.00, by which time the loco was definitely starting to struggle.

The ashpan is fitted with a front damper which is usually kept shut, however when we cracked it open, we found the whole ashpan, all 16 x 18 inches of it, was virtually full of ash. As we were in a hurry, we had little choice but to rake it out where the loco stood, and hope for the best for the afternoon running.

The second occasion was with the Shay, when I’d had it in steam for about two hours, burning roughly 60 per cent Trevithick and 40 per cent lump coal blend. An hour into the public running and wary of the trap, I had a quick peek in the ashpan through the damper, and found that the fuel had already created a little peaked mountain of ash in the middle, virtually touching the bottom of the firebars. I managed to rake it out flat

“When we cracked the damper open we found the whole ashpan, all 16 x 18 inches of it, was virtually full of ash...”



PHOTO 17: Wildfire resulted in very little clinker in firebox of ‘Myglyd’...

PHOTO 18: ...but the ashpan of the Trevithick-fired ‘Dr John’ was full of lumps of clinker.

PHOTO 19: Myglyd’s ashpan produced a fine, almost graded ash dust.

PHOTO 20: Similar story in the smokeboxes – plenty of foreign matter in that of Dr John...

PHOTO 21: ...but again a fine residue in the ‘box of Myglyd.

across the full area of the pan, and did another hour and a bit running. Come the end of the day though, the pan was virtually full.

Since conducting this testing session, CPL in conjunction with testing on preserved railways, has produced a new blend the company is calling Wildfire Heritage. We’ve not yet tested this as a fuel, just the original blend Wildfire, but apparently this is in response to the concerns around the chlorine found on copper.

As I stated earlier, we have paid particular attention to the fireboxes on both Romulus locos this year having used this fuel, and we’ve found no evidence of the green coating reported at Keighley.

Interestingly at the time of writing, I can find no source of Hargreaves’ ‘Trevithick Welsh Steaming Ovoids’. I know it was ultimately deemed to be the least favourite of the processed fuels by the preserved railways, and indeed our own trials pretty much bear the same results, and it seems as though it may have been withdrawn. **EIM**

■ Part one of this series appeared in last month’s issue of **EIM** – to order a printed or digital back issue see page 15. Edward will be continuing his trials with potential future fuels next month including another alternative developed from rapemeal, a 100 per cent renewable source and called Green Coal, though dubbed by some observers as cheese!

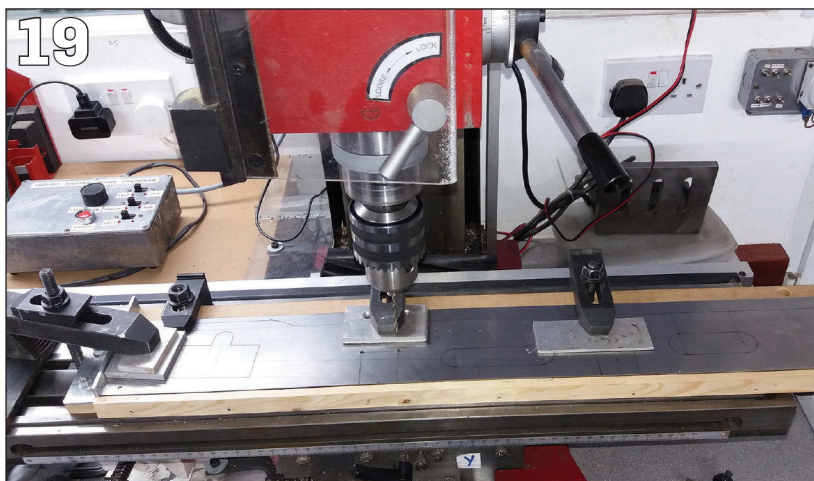
An early version of the Green Coal was trialled by Tech-ed Harry on the Fairbourne Railway (**EIM** Dec 2021), and the current Jan-Feb 2023 edition of **EIM**’s sister magazine *Narrow Gauge World* includes an in-depth feature on the continuing development process with this fuel. To order a copy go to www.world-of-railways.co.uk/store/latest-issue/narrow-gauge-world



Conway – a first steam locomotive build

This month in his short series designed to take some of the mystery out of loco building for novices, Rich argues that you shouldn't be scared of building a boiler...

BY RICH WIGHTMAN Part Three of four



So having decided on which loco to build, let's make a start. The obvious place to begin a project is with the frames – after all everything else is fixed to them. If you don't fancy the idea of making the frames, have a look at one of the companies that offer laser-cut frames – these can save a lot of time and effort.

The frames are made as a pair, the two plates being fixed together and machined as one. Some careful drilling and machining is required to ensure everything will be square and work properly. Most but not all of the holes are drilled right through both plates – some will be in one frame only. Take note of the hole sizes marked on the plans – some are tapping-hole size and most plans show imperial dimensions as mentioned last month, so if you are moving over to metric fasteners the hole size will need

to be adjusted accordingly, so study the plans well.

Frame construction is where DROs (digital read-outs) on the milling machine can come into their own. The frames for my Conway, some 26 inches in length, exceeded the capacity of my mill so I fixed the two frames to a piece of MDF (Photo 19). With an edge finder I located a datum and machined the front half of the frames. Then I moved the whole lot along, found another datum and machined the rear half. I do wonder how the engineers of old did this with a hacksaw and file and marked it all out with a ruler and scriber?

One measurement that must be accurate on the frames is the spacing of the horn cut-outs, to make sure the axles will run at the correct spacing from each other and that the coupling and connecting rods will all fit



PHOTO 19: Conway's frames mounted on a lump of MDF for milling out.

PHOTO 20: Assembling the frames, note the use of a flat surface to ensure all angles are square.

PHOTO 21: Rather than pay for expensive castings that would then need machining, Rich turned his wheels from solid bar.

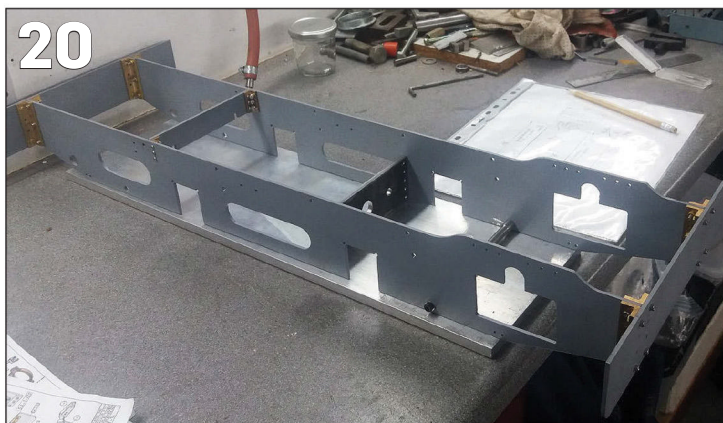
Photos by the author

properly. The horns can be made and fitted now – a good tip is to leave the final machining until they have been fitted, then clamp the two frames together and machine across the two openings thus ensuring they are square with each other.

Having done that it's a case of making up the stretchers and the front and rear buffer beams. Angle iron is used to fix buffer beams and stretchers to the frames but be wary of it – it's very rarely a true 90 degrees to start with. It's best to give it a skim over in the mill first (don't ask me how I know).

The plans may specify that some parts are riveted together but I prefer to use nuts and bolts, so that the joined components can always be dismantled if required. When bolting it all together, use the lathe or mill table, or something of known flatness during the assembly process to ensure it is all square (Photo 20).

The next job is to make up the axle boxes and turn the wheels. The wheels on Conway are solid so I turned them from steel discs, which was much



cheaper than buying the castings (Photo 21). I made up a pair of temporary axles from aluminium bar so that I could get the frames onto the wheels. It's a good idea at this point to make up a short length of track from bar or angle iron for the loco to sit on. It rolls up and down now (Photo 22) – I felt like a big kid with a new push-along toy, a real encouragement to crack on with the rest of the project.

Boilers – nothing to fear

On which note... departing from convention, now is the time to build the boiler. Don't put it off like I did, get on with it. The rest of the loco is machine work so it can wait.

I'll show the main bits required, which are similar to most boiler designs to give you an idea of what's involved. Before attacking the copper I produced a mock-up from a piece of plastic drain tube, and some scrap cardboard with actual-size prints of the boiler plates glued on. I found this a great help and enabling me to visualise things a lot more clearly (Photo 23).

Study the plans, get your head around what you are doing, talk to the experienced guys on the forums and down at the club. Arguably copper is the most expensive material you will have to buy for your project so it's preferable that you make no mistakes.

Copper is funny stuff to machine and must be held rigidly. Tools will grab and stick and damage the material so it must be clamped securely at all times. To hold the barrel in the lathe I made up some blocks of wood I screwed a piece to the face plate and machined it to a tight fit in the barrel (Photo 24).

Another piece of wood was machined to a tight press-fit into the other end. A length of 10mm threaded rod went through the centre to hold it all together. Support from the tailstock will hold the tube rigidly enough to take light cuts (Photo 25). Another simple jig of ply or MDF will hold the assembly rigidly in the mill for cutting and drilling the various holes (Photo 26).



"I felt like a big kid with a new push-along toy..."

PHOTO 22: Making up some temporary axles produces rolling chassis and lots of encouragement.

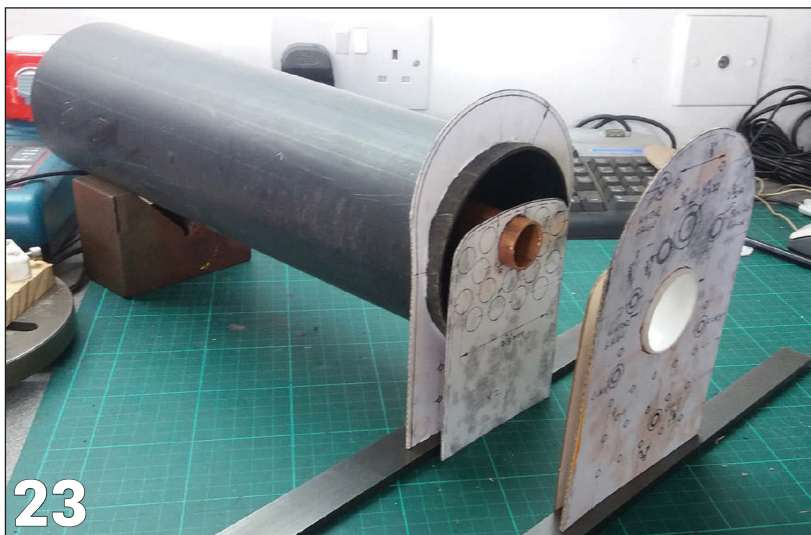


PHOTO 23: A mock up of the boiler to gauge sizes and such.

The next job is to make up some flanging plates as formers for the copper plate. Here I printed out exact-size templates from the plans

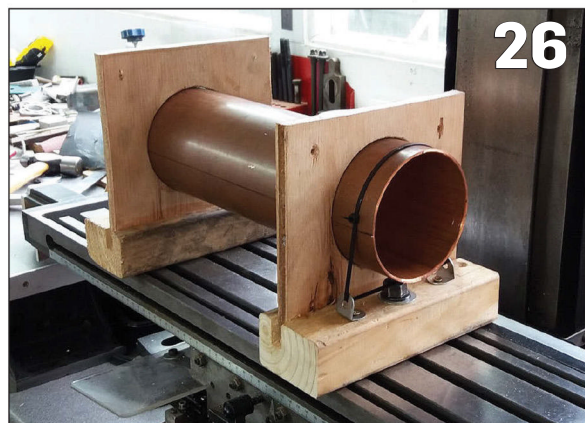
and spray-glued them to the plates. Photo 27 shows the smokebox tubeplate former which is turned from aluminium. You could use marking ▶

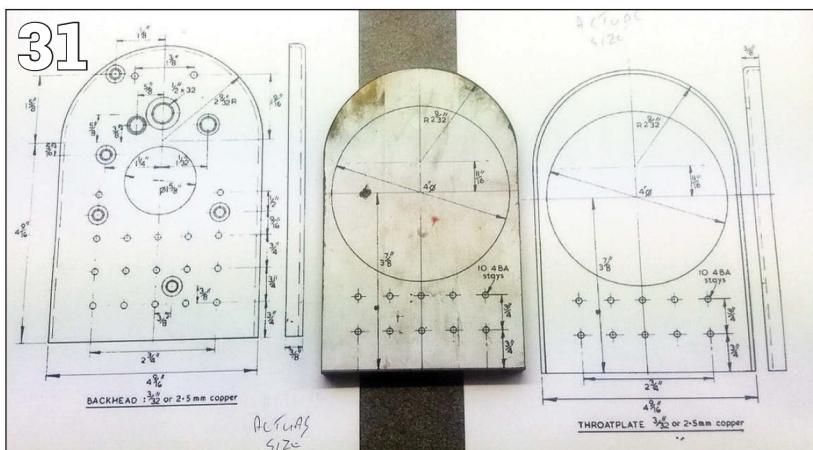
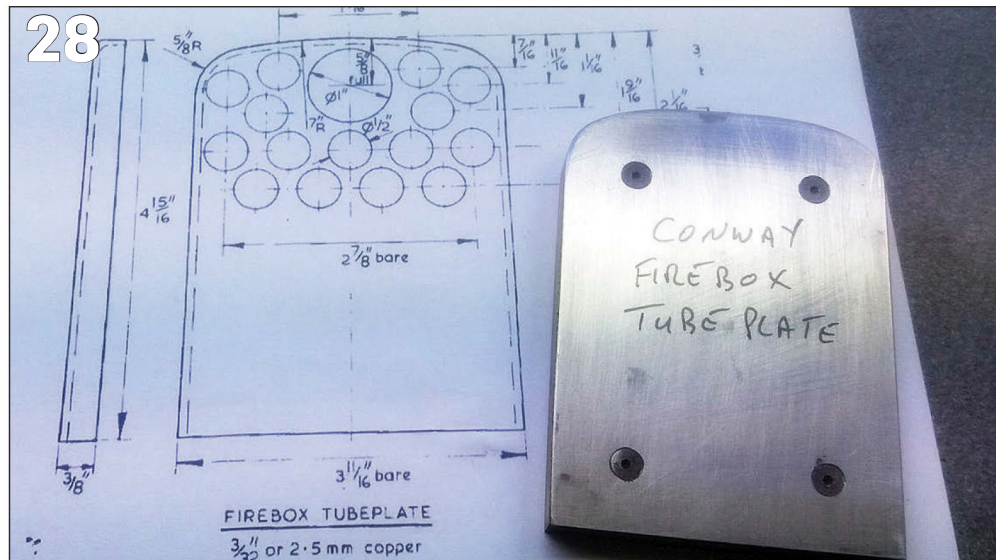
PHOTO 24: Blocks of wood machined to tight fit for holding boiler.



PHOTO 25: Tailstock helps support boiler tube in the lathe.

PHOTO 26: Jig made up for holding the boiler tube in the mill.





fluid but I find it clearer to write on white paper. Chances are you are only going to use these flanging plates once so there is no need to use $\frac{1}{2}$ -inch thick steel, aluminium will do.

I had a piece of formica about $\frac{3}{8}$ -inch thick onto which I screwed some $\frac{3}{32}$ -inch thick steel, this worked perfectly for the firebox tubeplate former (Photo 28-29). The throatplate and backhead use the same former – I made this one from the formica with three $\frac{1}{8}$ -inch thick steel strips screwed to it (Photo 30-31).

On a stationary boiler I built a while back I actually made a punch

PHOTO 27:

The aluminium former for the smokebox tubeplate with its drawing.

PHOTO 28:

Firebox former, again with its drawing.

PHOTO 29:

Former screwed to formica for flanging.

PHOTO 30:

Parts for making backhead and throatplate.

PHOTO 31:

Completed former made up for flanging.

FIGURE 2:

Diagram showing calculations for making up the smokebox tubeplate former.

PHOTO 32:

Copper sheet cut out for flanging plates.

PHOTO 33:

Forming the smokebox tubeplate.

PHOTO 34:

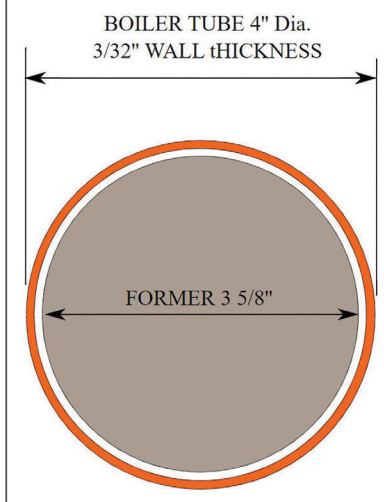
Smokebox tubeplate test fitted in the boiler tube.

and die out of oak and used my hydraulic press (featured in these pages in March 2012) to form the plates, and it worked. The former needs to be the right size, obviously, so a bit of maths is needed. As an example to make the front tubeplate, Conway's boiler barrel is 4-inch outside diameter with a wall thickness of $\frac{3}{32}$ -inch. The inside diameter of the barrel will be 4-inch minus $\frac{3}{32}$ -inch minus $\frac{3}{32}$ -inch which equals $3\frac{13}{16}$ -inch.

The flanging former must be the inside diameter of the boiler less twice the thickness of the tube plate which is $\frac{3}{32}$ -inch. So $3\frac{13}{16}$ -inch minus $\frac{3}{32}$ -inch minus $\frac{3}{32}$ -inch equals $3\frac{5}{8}$ -inch. Figure 2 might make things a little clearer. This rule applies to all plates that are fitted inside the barrel and wrappers.

I radiused the corner of the formers a little so that there wasn't a sharp edge that would cut into the copper. I then spray-glued the print-outs with the extra flange allowance onto the copper sheet and cut them out (Photo 32).

FIGURE 2



To make the smokebox tubeplate I cut a disc of copper big enough to allow for a $\frac{3}{8}$ -inch flange, in other words $3\frac{5}{8}$ -inch plus $\frac{3}{8}$ -inch plus $\frac{3}{8}$ -inch which equals $4\frac{3}{8}$ -inch. It only needs to be neat enough, not dead accurate as the flange is inside the boiler barrel and can't be seen.

On the beat

I annealed the copper by heating to cherry red and dunking in cold water. I held the former centrally on the copper plate and clamped the two tightly in a vice. With a soft mallet I then beat the edge of the copper over the former, turning in the vice to get all around (Photo 33).

You will find the copper bends very easily for a while but will then need to be re annealed several times to complete the flanging. Aim to get it as circular as possible and if all goes well it should be a snug fit in the barrel (Photo 34). I then trimmed with a file until it was an easy fit – silver solder needs a small gap to be able to flow. I then made up all the other plates in a similar fashion.

To drill all the holes in the plates I once again printed out actual size from the plans and spray-glued them to the copper plates. I'll just describe the technique for the smokebox tubeplate – all the plates were drilled in a similar fashion. I drilled four holes and screwed the plate to a scrap of 4x3 (Photo 35). Normal twist drills will not drill an accurate round hole so I used a step drill (Photo 36). The screws will have to be moved as the holes are drilled. The aim is to drill the holes slightly undersize then use a reamer but only just enter the reamer.

I cut the fire tubes and superheater tubes to length and very carefully in the lathe skimmed a little off each end diameter (Photo 37). The idea is that the tubes will enter the drilled holes in the tubeplates but not go right through – this makes assembly so much easier. I made three or four small nicks in each drilled hole with a small triangular file. This

would help the silver solder flow through to both sides.

I next made up the inner and outer firebox wrappers. I made formers from layers of MDF glued together to shape the wrappers (Photo 38). Photos 39-40 show the wrappers being formed. With a few clamps and

PHOTO 35:

Tubeplate mounted on to a scrap piece of wood.

PHOTO 36:

Using step drill to drill tube holes.

PHOTO 37:

Light skim off the fire tubes to aid fitting.

PHOTO 38:

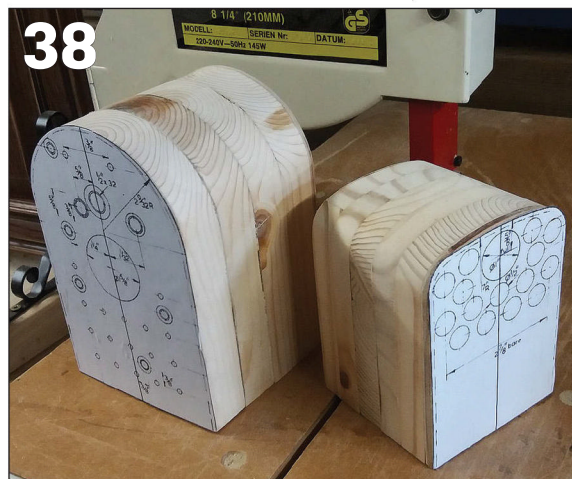
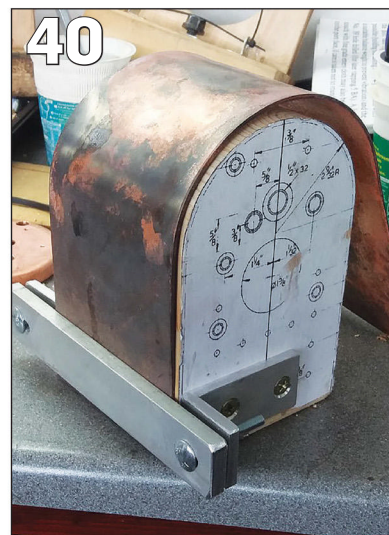
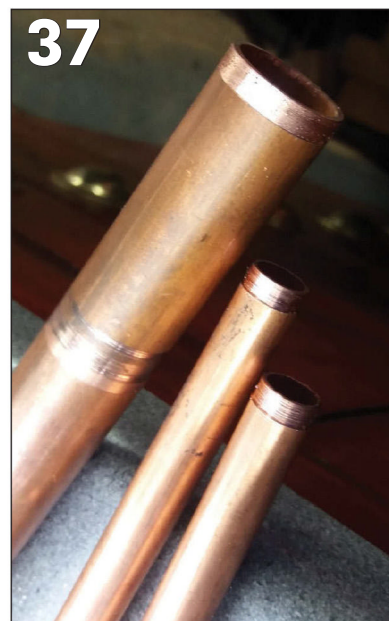
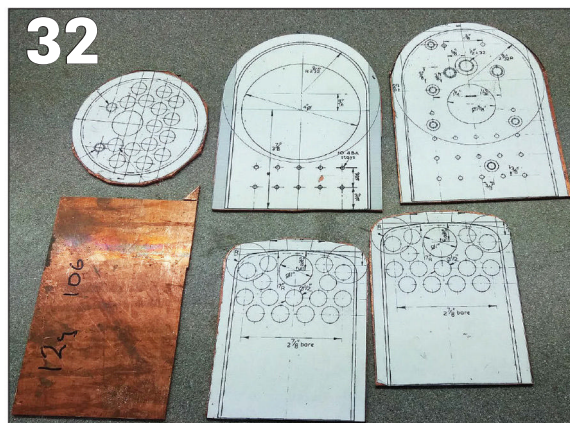
Inner and outer formers for firebox wrapper.

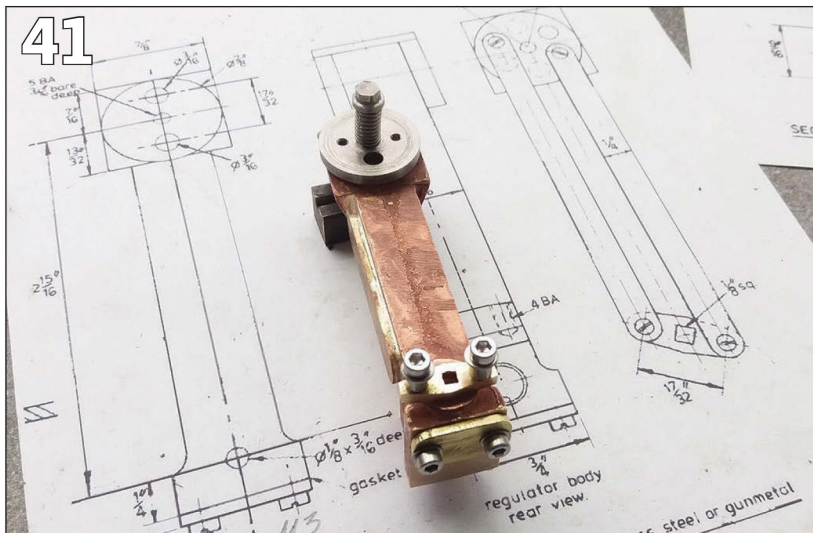
PHOTO 39:

Forming the outer wrapper.

PHOTO 40:

A clamp screwed to the former to hold the wrapper for bending.





brackets and the copper annealed they can be persuaded around the formers quite easily.

Next is to make up all the bushes that are needed for the boiler. These must be bronze – under no circumstances use brass, which is an alloy of copper and zinc. Under steam and through time dezincification can occur which is where the zinc leaches out and weakens the brass to the point where it can fail. Bronze is an alloy of copper and tin and does not suffer from the same problems.

You should not finish threading the bushes at this stage, use only the first taper tap. The heat from silver soldering can weaken the threads so it's much better to finish tapping afterwards.

Plug that hole

On Conway I drilled the bushes through which meant I had to make a set of plugs to blank them all off when I needed to carry out a hydraulic test. Another method is to make all the bushes blind, in other words not drilled through which saves on

making the plugs. They are then drilled through and tapped after the initial hydraulic boiler test.

If possible make the bushes a little thicker than specified, leave a bit more meat on the bone as it were. Doing this will allow a tap of the next size up to be used if the threads become weak. The dome bush can also be left a little thicker and wider and if possible it's good to up the size of the bolts/studs.

I'm going to drift off a little here. On Conway the regulator is of the Stroudley type (Photo 41). For those unfamiliar with this, it is basically a round disc with holes in it that sits on the face of a casting that has similar holes drilled in it. When the regulator is operated the disc turns to align or shut off the holes.

The first hydraulic test on the boiler is carried out at twice working pressure and Conway passed that okay. The second hydraulic test is carried out at 1½ times working pressure with all the boiler fittings in place including the regulator (all except the pressure gauge which could be damaged at high pressure).

"If possible wear rubber gloves while handling the parts – even a fingerprint can spoil a joint..."

PHOTO 41:

The Stroudley-design regulator, cause of some issues during the testing stage.

PHOTO 42:

Completed set of boiler parts ready for soldering.

PHOTO 43:

Silver soldering backhead to outer wrapper.

PHOTO 44:

Hand pump used for hydraulic test.

PHOTO 45:

Hydraulic test underway and the hunt-the-leak game begins...

This is where I ran into problems.

I just could not get the regulator to seal – half a dozen times or more it was removed, lapped, refitted, retested, removed again. It was modified to include an O-ring, a stronger spring, all to no avail.

Some research was done which revealed that this is a common problem. In the end I modified it to use a stainless-steel ball valve. Problem solved. I won't go into details here, it's too big a subject but if you go over to the forum I am on (<https://www.modelenginemaker.com/index.php>) and look up 'Conway' there is a full record with photos of how I did it.

Because of the constant stripping down and rebuilding the threads in the dome bush were getting weak, hence my reason for mentioning that one should make the bushes thicker if possible. Armed with the experience of Conway's troubles I have incorporated a ball valve in my new loco build which meant modifying the dome bush slightly. I leave it up to you to decide.

Putting it all together

It was time to silver solder all the boiler parts together and there is an assembly sequence to follow. I won't go into detail here as each boiler differs – as mentioned earlier most locos have a book or magazine series covering their building which usually describes each process in great detail and is well worth reading. There are also a number of books dedicated to boiler making.

What I will say, however, is cleanliness, cleanliness, cleanliness. All parts must be pickled and scrubbed then washed in clean water. If possible wear rubber gloves while handling the parts – even a fingerprint can spoil a joint. A couple of copper rivets here and there in the plates will stop them from moving when heating up.

Use plenty of flux and have everything you need to hand before you light the blow torch. Have a friend watching if possible to lend a hand when needed. Get everything really hot before attempting to apply the silver solder. When it's hot enough the silver solder will flow freely. The Cupalloys (usual disclaimer) website (<https://www.cupalloys.co.uk>) has useful information on silver soldering.

Photo 42 shows the boiler parts, some silver soldered and Photo 43 shows some silver soldering carried out to the backhead. Silver soldering is not difficult if these simple rules are followed but it does get easier with practice. I used far too much silver solder on this, my first loco boiler which is not a problem – it just adds to the expense. There are of course other



bits to be silver soldered in such as stays and the like, depending on the type of boiler to be made.

When the boiler is fully assembled it's time to give it a hydraulic test. First one needs to make up bungs for the bushes and seal them – I used fibre washers which are perfectly okay while the boiler is cold but must not be used to fire it, copper washers should be used at this time.

One also needs to make an adapter that screws into the safety valve bush and will take a pipe from the hand pump. I used my little hand pump (Photo 44) described in the May and June 2009 issues of this magazine.

Don't be tempted to pump the boiler up with compressed air, that can be dangerous – hydraulic testing with water is the safe way as the worst that can happen is you will get wet.

The technique is to fill the boiler to the brim, prime the hand pump and connect the pipe. A couple of pumps is all that's needed to get it up to 30psi – there is no need to go higher than that initially, no need to strain the boiler which will still be in its soft annealed state.

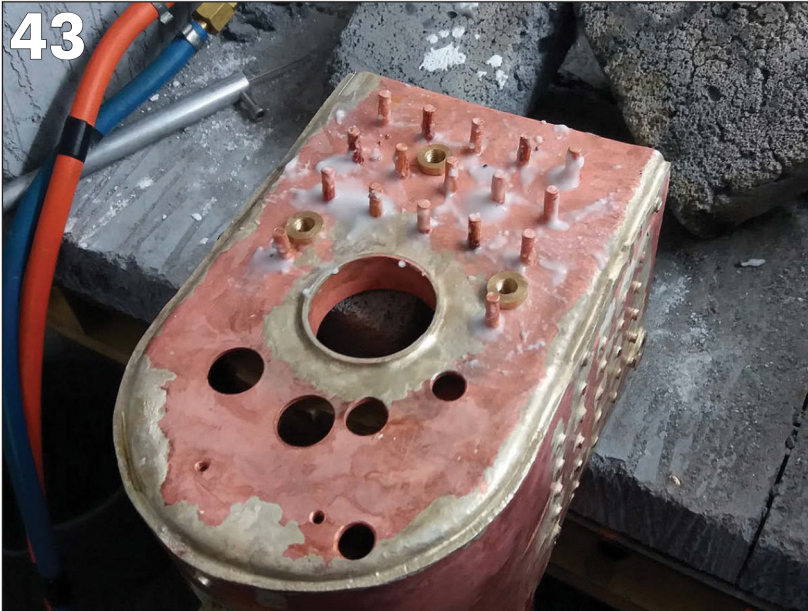
If you have done a perfect job you will be able to see the pressure gauge remain at 30psi (Photo 45). If it starts to drop you have a leak, or in my case several leaks! Note where they are, pickle the boiler again and wash in clean water, then re-solder and hydraulic test again.

Leak chasing

This process can become a bit disheartening but you have a fair amount of money and time invested in the boiler so stick at it. I went through it probably a dozen times or so – you fix one leak which then shows up another. Incidentally this is

"You have a fair amount of money and time invested in the boiler so stick at it..."

"A huge saving on the cost of a commercially made boiler along with the satisfaction of having done it yourself..."

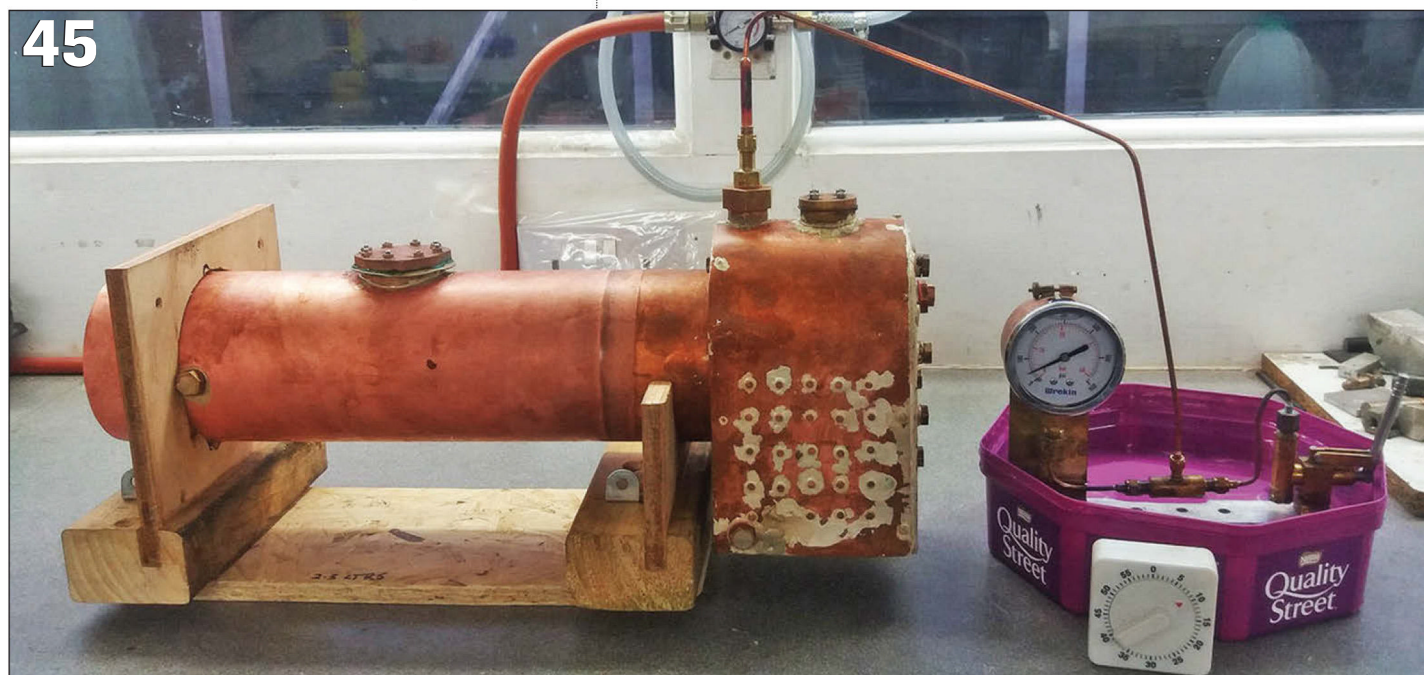


where the oxy/propane comes into its own, you can heat up very local areas.

Eventually you will have a boiler that holds pressure. Conway has a working pressure of 80psi so its initial shell test was done at twice that, 160psi. It only has to be done once in its life at that pressure so avoid testing it too often to avoid straining the boiler. Once you are happy, arrange with your club boiler inspector to have your boiler tested. If all is well he will issue you with a certificate and you can treat yourself to a drop of your favourite beverage.

If all has gone well you will have a boiler that should last a lifetime. A boiler of this size should cost around £400.00 for all the materials – copper tube, copper sheet, bronze, silver solder and flux. That's a huge saving on the cost of a commercially made boiler along with the satisfaction of having done it yourself. **EIM**

Rich concludes his short advice series next month. Parts 1 to 3 were published in the November 2022 to January 2023 issues of **EIM**, for how to obtain printed or digital back numbers, see page 12.



Wheely good progress?

The impending lack of a roof over his head provides our Tech Ed with a pressing deadline and a 12¼-inch gauge loco needing its axlebox bearings replacing...

BY HARRY BILLMORE



PHOTO 1:

Weighing 'Russell' using hydraulic cylinders joined to a gauge.

PHOTO 2:

Gauge reading pressure needed to lift loco.

PHOTO 3:

Scoring and heat damage caused by vesconite and lack of lubrication clearly visible.



PHOTO 4:

On leading axle end key ground away to allow crank to not sit on keyway.

PHOTO 5:

Somewhat tired wheel profile, nearly double flanged and no root radius to speak of.

PHOTO 6:

Cold weather in workshop caused some interesting smoke hanging in the air from the cutting oil.

Photos by the author

I left off last month's update with the long tale of woe that was the bottom end of the Fairbourne Miniature Railway's 6-inch scale Welsh Highland Railway-style 2-6-4T 'Russell'. Having discovered what I had to deal with, I now had to correct the issues and get the loco back on its wheels before Christmas. This is due to the workshop having a new roof put on it in January so I need everything I can move out of the way before then!

The first thing I had to do was decide which route to go down for the axlebox bearings, this would impact the machining of the wheels and axles as I had no desire to put the wheels into the lathe any more often than I absolutely had to. Unfortunately the bearing outer diameter is set by the 100mm size of the hole in the axlebox castings. Due to the wear on the axles caused by the poorly lubricated vesconite I couldn't fit the original-sized roller bearings which were 55mm internal diameter (id), the next inner bore size down was 45mm which was smaller than the portion of the axle where the crank attaches, as well as significantly weakening the axle at its highest stress point.

After a lot of head scratching and several phone calls to my bearing supplier a possible solution was found, a spherical roller bearing with a 100mm outside diameter and a taper bore combined with a taper-to-parallel adapter would allow a 50mm id.

Weighty matter

To ensure that this would not weaken the axles too much, I then needed to determine the weight of the loco to work out what the worst-case loading on one driving axle could be. I borrowed the weighing gear from the Tallylyn Railway (for which many thanks) – this consists of a pair of hydraulic jacks, a pump and a gauge. Because the jacks have a known ram size you can calculate the weight on them based on the pressure required to lift the loco (Photo 1-2). Russell it turns out weighs 4.3 tons.

I then followed the series of equations in the *Steam Locomotive Design: Data and Formulae* book published by Camden Miniature Steam Services (<https://camdenmin.co.uk>), to determine the load on the load-bearing section of the crank axle. This was fascinating as it includes the



bending moments from the crank, as well as side loading from going around a curve along with the weight shifting as well as numerous other details. If in future I can sensibly write this process up in a reasonably understandable way I will!

Once the loading was calculated I could then calculate the diameter of material required to cope with this loading. Thankfully the axles had been replaced along with the leading and trailing wheels six years ago so the axle material was known to be EN8. The minimum required diameter was 42.67mm, so a 50mm axle will have a healthy margin of safety.

This meant I could then start machining the wheelsets, although first I had to completely strip them down (Photo 3), removing the axleboxes and cleaning them up a considerable amount. This uncovered a couple of other bits of interesting engineering, such as on the leading wheelset where one of the keys had been ground down (Photo 4) so that it did not engage in the crank at all.

I suspect this was done when it was realised the machining of the new axle had been incorrect so to correct it one of my predecessors simply ground the key off and moved the crank, although not to the correct position as it turns out! Also revealed were yet more interesting wear patterns on the axle journals (Photo 4).

Side issue

Photo 5 shows the state of the wheel profiles on the rear drivers, on their way to being double-flanged, with no root radius left at all. This has a lot to do with having no side control on the rear bogie, so nearly half of the engine carries on in a straight line when going around some of the tight curves we have on the line before the rear drivers hit the curve and take all of the side loading of turning the engine. I hope to rectify this issue this winter.

I then proceeded to machine the



wheels, I have described this process in detail before so won't bore you with repeating myself! A couple of interesting things cropped up however – I was running the lathe as fast and hard as I dared to remove the material as quickly as possible due to the time constraints I had (Photo 6). This led to a reasonable amount of chatter (Photo 7) which took some careful and slow work to remove, so I am not entirely sure pushing the lathe that hard was worth it in time, I could possibly have got to the same place by going slightly slower and not having to take several very slow passes at the end to remove the chatter.

The other interesting thing was the wear pattern on the centre flangeless wheelset (Photo 8). This was extremely eccentric, and far worse than the others but I am not sure why, if anyone has an idea I would very much like to hear it!

Once all the machining was done (Photo 9) I then discovered yet another issue (Photo 10-11) – the balance weights were now very close to the ground due to the amount of material I had to remove. I found out subsequently that when the new wheels were put onto the loco, only the front and rear drivers were replaced and they were machined to the same size as the centre flangeless set, so the new wheels were made to an already very worn size.

Now that I had machined them down some more the balance weights were only approximately 5mm above the rail head, which as you can see in (Photo 12) means any slight difference ▶

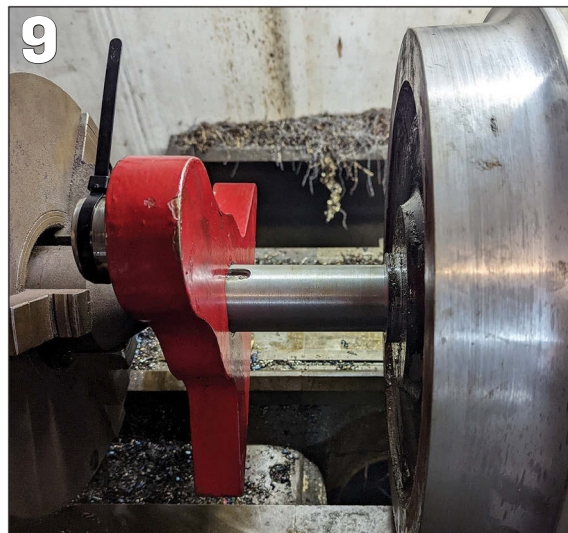


PHOTO 7: Turning wheels, chatter marks visible where lathe run a little too hard to remove material as fast as possible.

PHOTO 8: Centre flangeless drivers had some interesting eccentric wear patterns.

PHOTO 9: Finished outer profile turned and the axle turned down to accept the new bearings.

PHOTO 10: Wheel turning meant that balance weights were very close to hitting ground.

PHOTO 11: Crank pin end of crank had plenty of clearance.

PHOTO 12: The crank hitting the slightly raised concrete either side of the rails in the workshop.





PHOTO 13: Pressing the second axlebox apart only the vesconite came out, not the steel carrier.



PHOTO 14: Steel carrier clearly visible as the lighter coloured ring in the cast-iron box, not also the lip at the bottom which is also part of the cast-iron box.



PHOTO 15: Machining a slot out of the carrier to aid its removal.

PHOTO 16: Gradually getting closer and closer to the edge of the carrier.

PHOTO 17: Once the machining is complete, the carrier comes out easily.

PHOTO 18: The minimal amount of break-through on the carrier means there is only a tiny mark on the inner surface of the axlebox.

PHOTO 19: One of the vesconite bushes had a large crack in it even before Harry had a chance to press it out of the 'box.

PHOTO 20: Some of the axleboxes had grub screws holding the vesconite and carriers in. Inset shows four grub screws for two holes – across the three axleboxes this way there were two different thread sizes.



in height with any trackside furniture (level crossings being the prime example for us here) would cause the balance weights to foul the floor, and if any other debris is then added in to the mix, could potentially lift the wheel and cause a derailment.

The best solution to this problem would have been to tyre the wheels, but unfortunately I absolutely did not have time to do this, so the next best solution was to machine the balance weights down a little to provide a little more clearance. I could do this thanks to the crankpin side being quite a lot shorter than the balance weight side. This may cause issues with balancing later on, but as we only run at 8mph it shouldn't be too much of an issue.

Before I started machining the cranks however I wanted to get the axleboxes finished and attached to the wheelsets, so I set about stripping them down. Unfortunately the five remaining axleboxes to be stripped all parted with the steel sleeve left behind in the axlebox and the vesconite coming out by itself (Photo 13).

This was an issue because there was then no way of pressing the sleeve out, as its inner diameter was smaller than the inner diameter of the casting (Photo 14). This meant I had to carefully machine away the sleeve until I broke through enough to pull it out easily (Photos 15-18).

During all of this process I also discovered some variety in the axlebox design, with some having grub screws holding the vesconite in place, others having locking grub screws on top of these grub screws as well as two different thread sizes used (Photo 19-20).

Which is which?

Combined with this was a theme of random letter stampings, with the example shown here (Photo 21) having both RF (right front) and RR (right rear) stamped in it, despite being removed from the left middle axle... This combined with the weld



spatter/pip left on the adjusting ring for the side control that had scored the wheel nicely (Photo 22-23) had me stopping for a brew and a little time to cool off!

Dress to impress

With all of the axleboxes assembled and on their axles, I then machined a lump of mild steel to become a mandrel to hang the cranks on and machine down the balance weights. I also took the opportunity while the driving cranks were in the lathe to dress the crankpins back to parallel and round.

This is done with a file to start with, using a sweeping motion with your driving hand in the opposite direction that you want the curve of the workpiece to go in, carefully working round the crank pin and checking frequently with a micrometer for size and ovality. The pin is then finally finished off with emery cloth (Photo 24-26.)

While machining one of the centre cranks (Photo 27), I came across an extremely hard spot – this might have been something embedded in the crank during its working life with the



PHOTO 21: Recurring theme – axlebox stamped up both RR for Right Rear and RF for Right Front...

PHOTO 22: Axlebox cover plate with side-control setting ring welded onto it had a large weld spatter sitting proud.

PHOTO 23: weld spatter has caused much grooving and general 'chewiness' on the wheel centre.

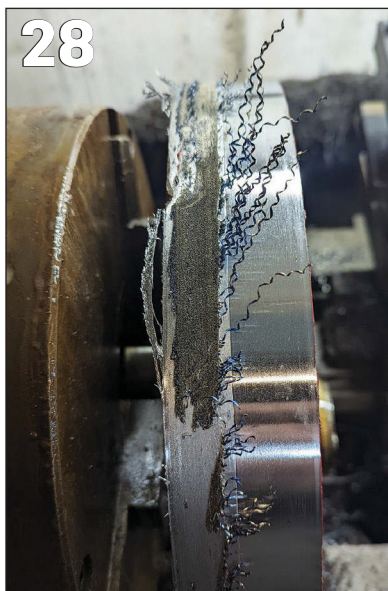
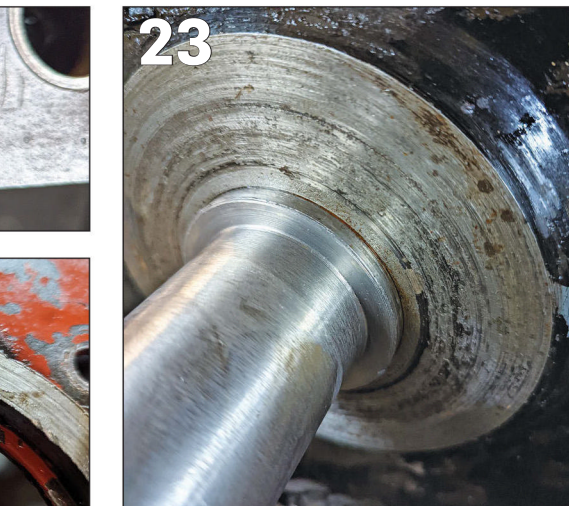
PHOTO 24-26: Grooved main driving crankpin, ridge in middle will only allow oversize coupling rod bush to fit over it. Careful attention with a file removes worst of ridges followed by further attention with various grades of emery cloth to produce round and parallel crankpin.

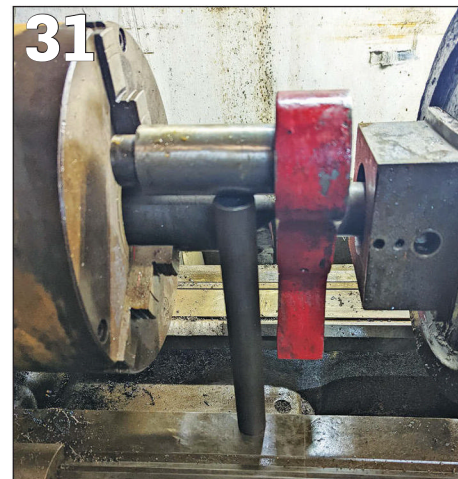
PHOTO 27: Machining down the balance weights to provide more ground clearance.

PHOTO 28: can you tell where the really hard bit is that kept ripping apart tips?

tight space between the rail height and the balance weights, or it could have just been a hard spot in the casting. Either way it destroyed several tool tips and I resorted to using some of my stash of part mangled tips that I keep for occasions just like this. These have lost their fine cutting edge but will still cut, and using them means you do not waste brand-new expensive tips on a cut that is pretty much guaranteed to destroy them. You do however then have to tidy up the terrible surface finish with a fresh tip later (Photo 28).

Photo 29 shows the improvement in clearance for the balance weights, ▶





there is 20mm now and I am much more comfortable putting the loco back in traffic like this.

Quarter back

The last job before refitting the wheelsets was to quarter them correctly. I did this by fitting both cranks to the driving axle with their keys and tightening down the taper lock bushes to final torque, then putting it between centres in the lathe.

As before when checking the quartering, I made a stop to sit on top of the carriage for the right-hand side (RHS) crank, then machined a piece of tubing to act as a stop for the left-hand side (LHS) crank (Photo 30). As a final check I set the dial indicator to zero for the bottom of the LHS crank pin.

I then fitted the RHS crank to the other two axles and tightened them down to final torque before loosely fitting the LHS cranks and putting them into the lathe between centres. Putting the RHS crankpin onto the stop I had made earlier, then rotating the LHS crank until the crankpin rested onto the tube I had machined to length (Photo 31) sets the quartering to the same as the driving axle. I then locked off the taper lock bushes and double checked the quartering with the dial indicator.

With that the horn guides could be measured and the centres calculated ready for the new rods to be machined before the wheelsets were refitted, with correct identification added (Photo 32). The loco was then lowered back onto its wheels (Photo 33) and moved out of the workshop with half a day to spare to start tidying up before the roof comes off.

Alongside my work on Russell, one of our hard-working volunteers has been beavering away on one of the carriages that sees extremely high mileage due to it being at the head of one of the sets. This is now having a major body rebuild with pretty much all the ply panels being replaced and a reasonable amount of re-framing as well! (Photo 34). **EIM**

PHOTO 29:

Balance weight now offers approximately 20mm clearance from rail height.

PHOTO 30:

Right-hand side crank pin resting on a carefully set block.

PHOTO 31:

Machined bar used to set the quartering.

PHOTO 32:

Front axle at one end is stamped F and then has the L and R overstamped.

PHOTO 33:

This is the other end of the front axle with an F and the an L and R overstamped.

PHOTO 34:

Russell finally back on its wheels and just in time...

PHOTO 35:

One of the line's always-in-use carriages having a lot of attention, lots of new panels and a reasonable amount of re-framing required.

Building a ride-on tender from scratch

Brakes and their control are the matters in hand this month as Peter and Matthew continue to build their 'beginners' project 7¼-inch gauge ride-on tender.

BY PETER AND MATTHEW KENINGTON Part Four of 11

The brake blocks for our 7¼-inch gauge ride-on tender were made from a laser-cut brake-block ring. We designed this ring in CAD and it formed a part of the (fairly substantial) laser-cutting job which was undertaken by a local company.

The ring was cut from 15mm mild-steel plate – mild steel is acceptable in this case since the wheels are also manufactured from mild steel. With cast-iron wheels, there is a danger of the brake blocks wearing the wheels (rather than the other way around), if they are fabricated from steel. If, however, the braking system is only ever going to be used for parking, with the brakes fitted to the loco serving to stop the train (in addition to vacuum brakes on the carriages), then this may be less of an issue.

The dimensions of the brake-block ring are provided in **Figure 35** and the resulting individual brake block dimensions are shown in **Figure 36**.

The techniques used in machining the brake blocks were described in our articles entitled *An Outstanding Job* (EIM, July-August 2021) and so will only briefly be recapped here.

The ring was drilled first, on the 'spotted' marks produced by the laser-cutter (**Photo 42**). We deliberately chose not to have the holes laser-cut since doing so can be problematic on such thick material (15mm). Small holes on thick material will often come out poorly – as a



general rule of thumb, holes that are much smaller than the thickness of the material can be an issue and it is usually worth checking with your supplier, if such holes are needed.

We also deliberately did the drilling operation first, as this saves cleaning-up the exit holes (assuming that your entry holes are 'clean') – the lathe can remove the swarf when facing the piece. The resulting ring is shown in **Photo 43**.

Machining the faces of the ring is fairly straightforward (**Photo 44**) – they only need 'cleaning up' a little (if at all), with the ultimate thickness of the blocks not being too critical.

The next task is to cut the grooves or slots into the outer edge of the ring, which will house the brake hangers (**Photo 45**). Again, our three-jaw

Continued on page 36

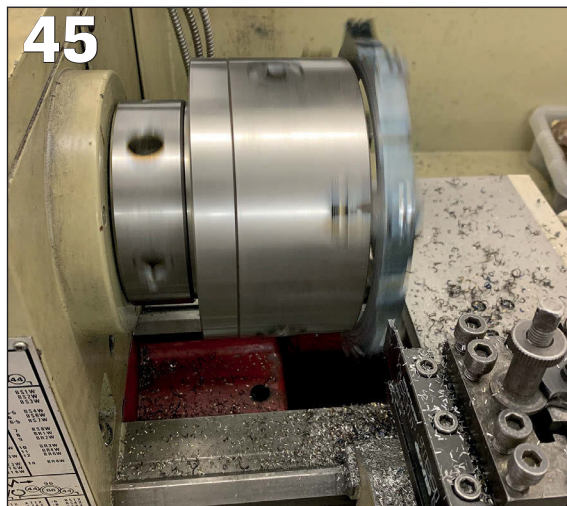


PHOTO 42: Drilling on 'laser-spotted' marks.

PHOTO 43: 7¼-inch Brake-block ring after drilling, before machining – up to eight blocks can be made from this.

PHOTO 44: Facing brake-block ring. Authors' three-jaw chuck was big enough for this operation.

PHOTO 45: Parting tool being used to cut 'slots' to (ultimately) accommodate the brake hangers.



*All drawings approx full-size unless stated.
All dimensions in mm*

FIGURE 35
Brake block ring
(drawn half full-size)

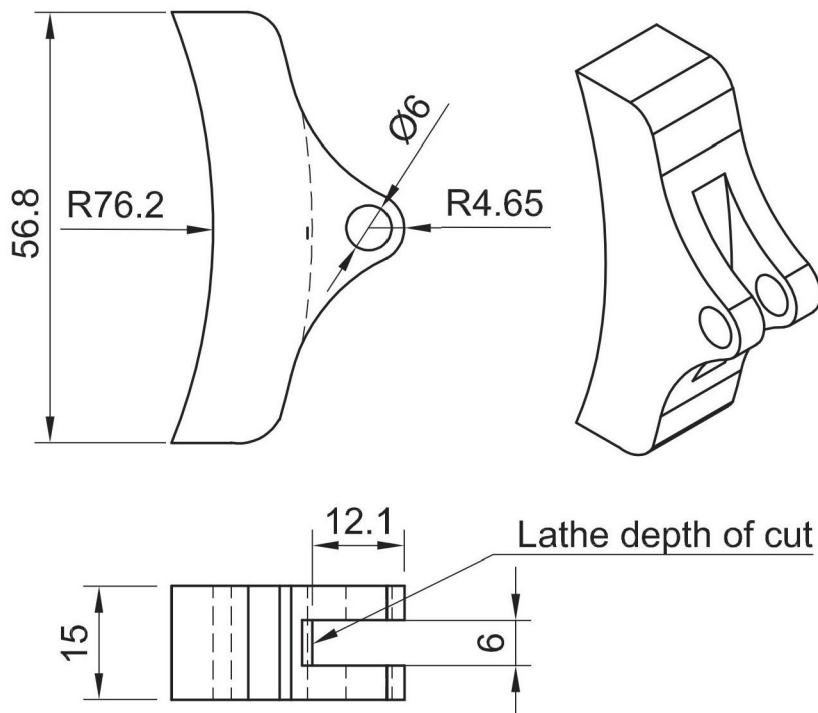
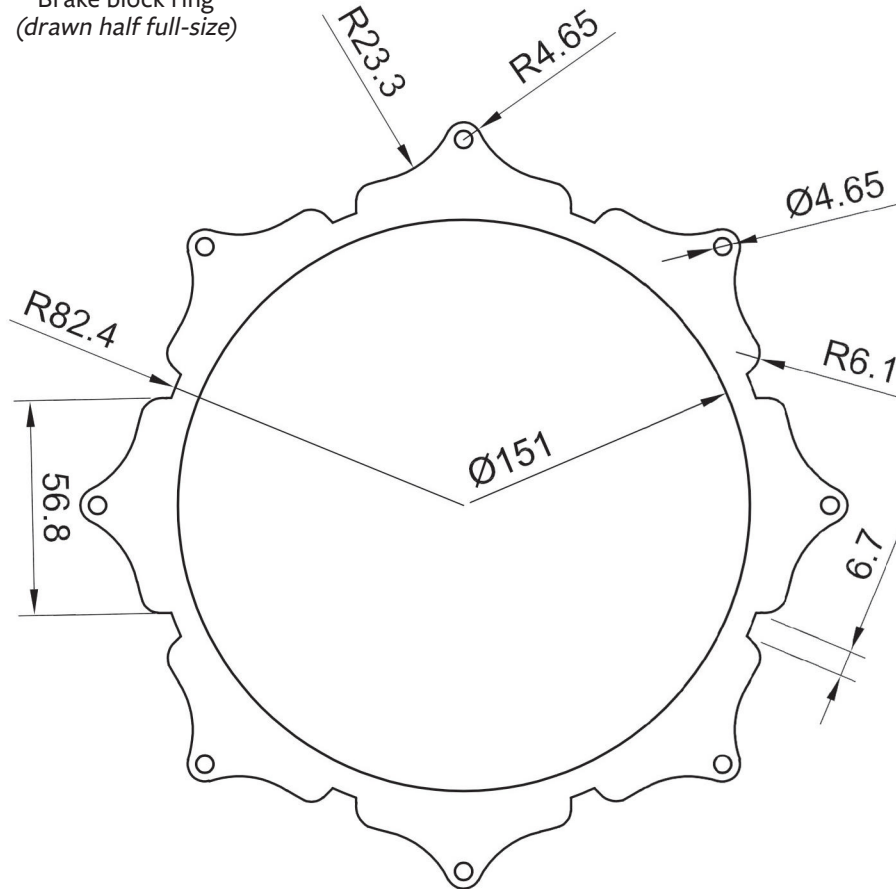


FIGURE 36
Brake block dimensions

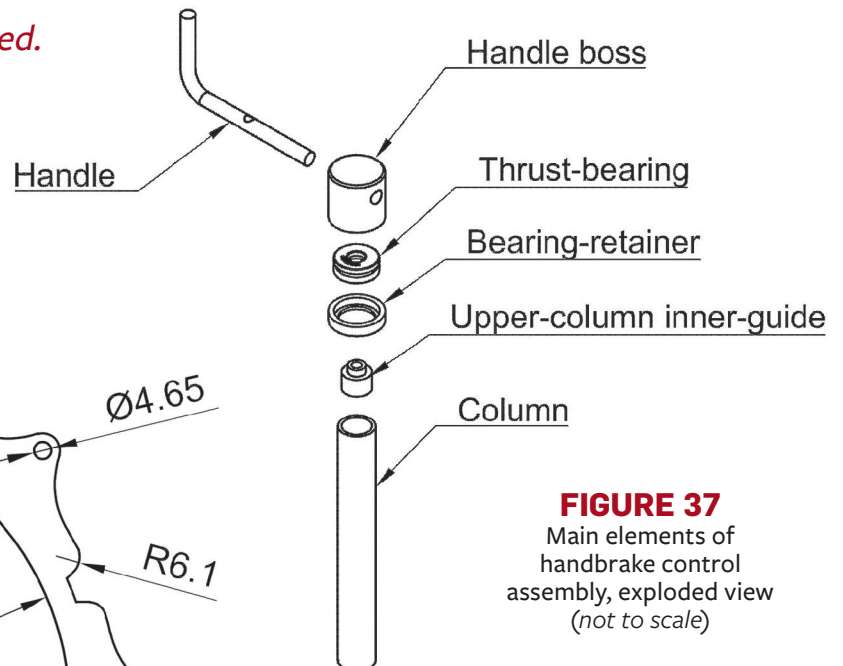


FIGURE 37
Main elements of
handbrake control
assembly, exploded view
(not to scale)

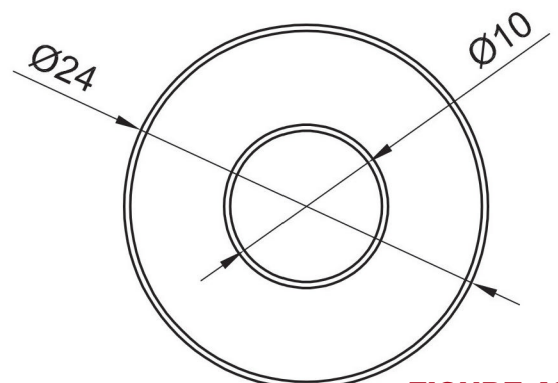
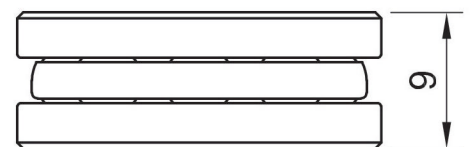
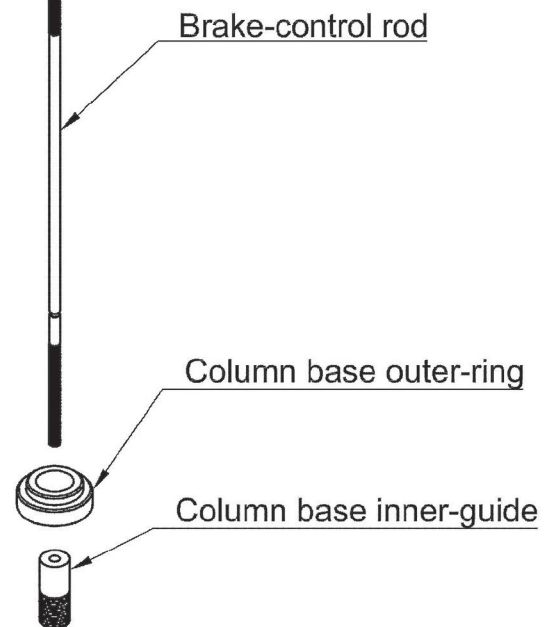


FIGURE 40
Thrust bearing
(Commercial part)

FIGURE 38

Handbrake control handle

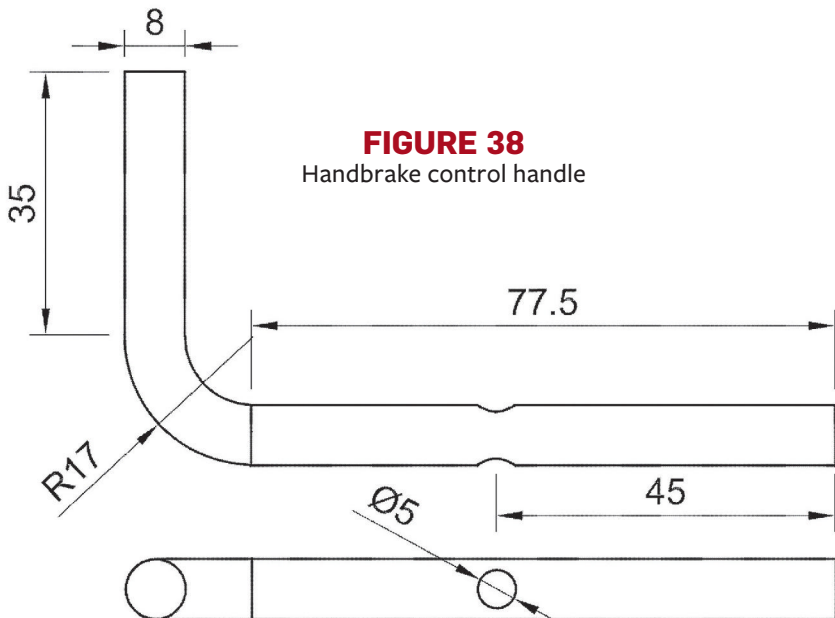
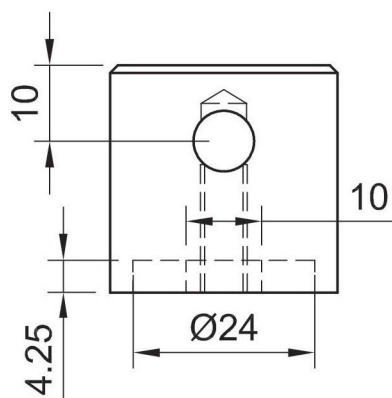
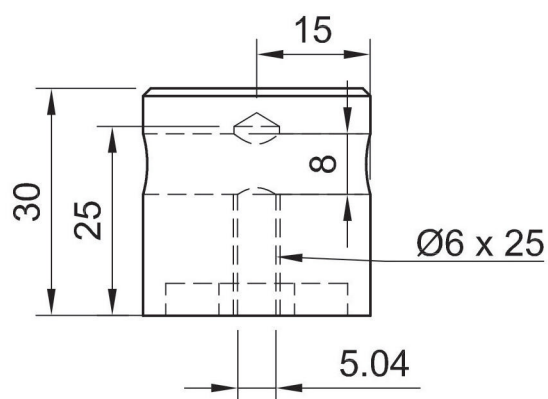
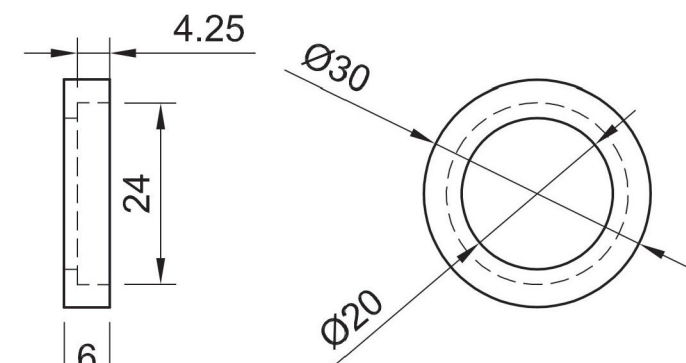


FIGURE 41

Thrust bearing retainer



← FIGURE 39

Handbrake control boss

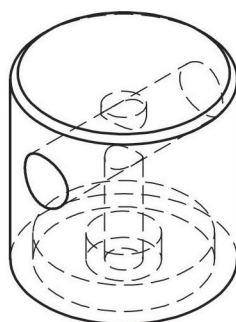


FIGURE 43 →

Handbrake control column

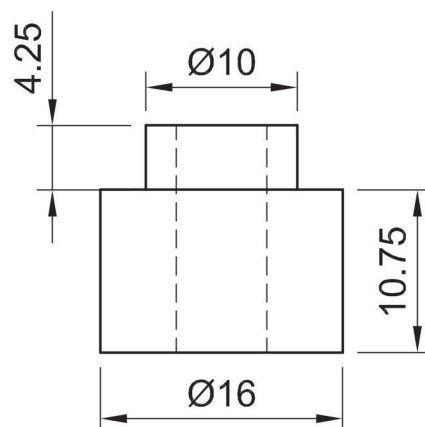
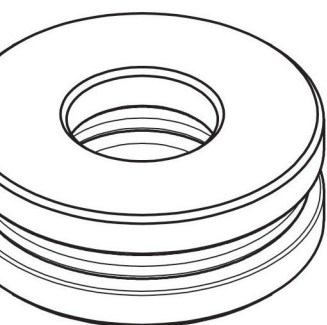
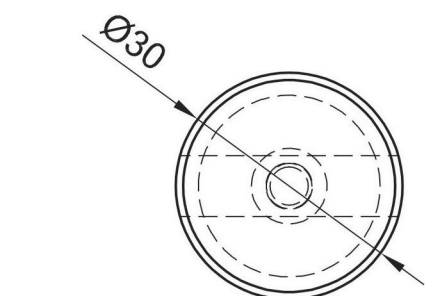
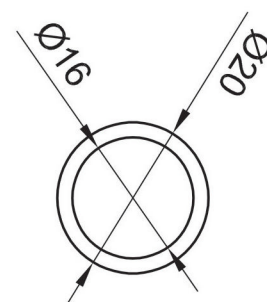
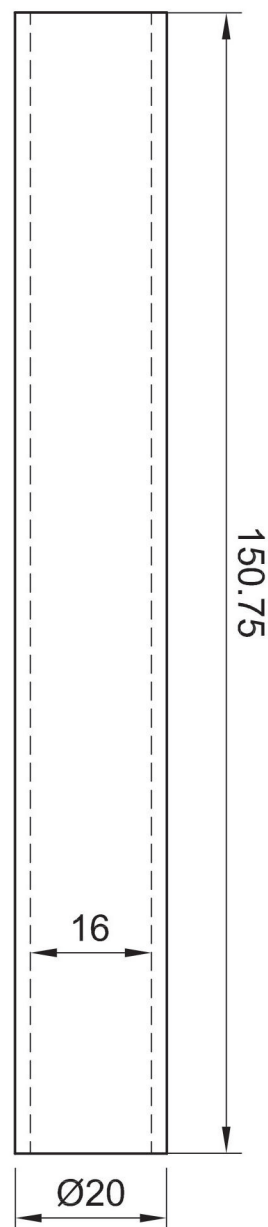
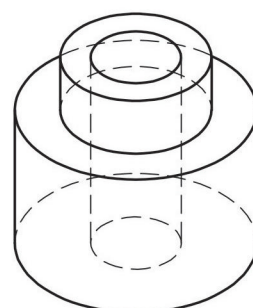
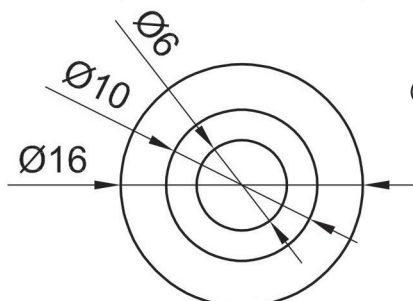
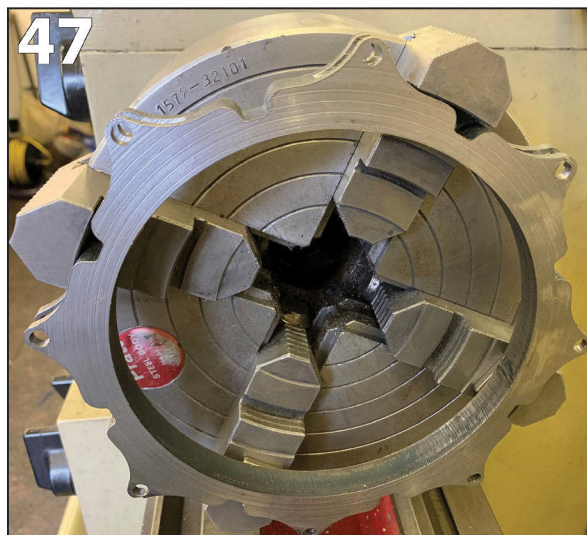
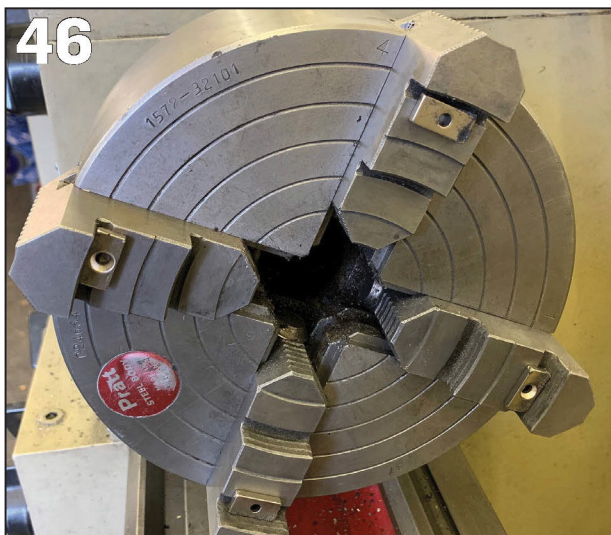


FIGURE 42

Control rod guide
(fits to upper part of
handbrake column)





"We wanted to ensure that it had a nice 'feel' during operation and yet retained a relatively simple construction from a machining perspective..."

Continued from page 33

chuck was adequate for this, as we were clamping the inside of the ring.

We used a 'stand-off' mechanism to ensure that the lathe tool wouldn't hit the chuck jaws when machining the inside of the ring (neodymium magnets, **Photo 46**). This we did on a four-jaw chuck (**Photo 47**) as our three-jaw was not big enough to clamp the outside of the ring! We therefore had to clock-up the part (**Photo 48**) – all good engineering practice for Matthew. The magnets should be removed once the piece is clamped, prior to starting the lathe (**Photo 49**).

Finally, the individual blocks can be separated with a hacksaw and the ends cleaned-up with a file. All being well, they should look something like **Photo 50**.

Handbrake Control

The handbrake control column is perhaps a little more complex than some designs, however we wanted to ensure that it had a nice 'feel' during operation and yet retained a relatively simple construction, from a machining perspective. Again, there are aspects which we TIG-welded, but which could equally be silver-soldered or possibly Loctited, if you are not

comfortable with welding or don't have the facilities.

An 'exploded' view of the column is shown in **Figure 37**. The design calls for most items to be held mechanically, to enable easy dis-assembly (such as for painting), with only a couple of aspects being welded and neither of these being 'structural', in other words relying upon the strength of the weld to obtain a good braking force.

The Handle

The handle was made from 8mm diameter, ground silver-steel (**Figure 38**). We chose this for two reasons:

- 1) The fact that the rod was precision ground made obtaining a tight fit into the handle boss fairly straightforward
- 2) Silver steel is a little more rust-resistant than mild steel and we planned not to paint this component, if possible, partly for aesthetic reasons and partly through pragmatism: paint will inevitably wear off in use.

The handle was bent using a vice-mounted bending tool and this worked extremely well. It was the first time we had used such a tool and we were very impressed with the results. A fuller discussion of the process will be provided in due course, in relation to the mountings for the bodywork.

The ends of the handle were rounded (prior to bending) by careful use of a file on the parted-off length of rod mounted in the lathe. We tend to use a collet-chuck for this type of process, as it is far safer than a conventional (jawed) chuck, should a lapse of concentration occur and hands stray too close to the rotating chuck's jaws. The rod used for the handle is quite thick (8mm diameter) and hence pretty rigid, so a fairly large stick-out can be used for this process, thereby making things a little safer.

Handle Boss

This was made from a section of 30mm diameter mild steel, taken from the same rod used for the axles. Only a short length (30mm) is required and this was available from the remainder of the rod, once the axles had been made. The dimensions of the part are provided in **Figure 39**.

On the lathe, the outside of the rod is first 'cleaned up', either using emery paper or by taking a skim with a lathe tool, depending upon the state of the rod to begin with. The centre hole can then be drilled to the depth shown in **Figure 39**, using a 5mm drill (M6 tapping size), not forgetting to start with a centre-drill of course. The

PHOTO 46: Magnets placed to 'stand-off' the workpiece from jaws and protect them from damage.

PHOTO 47: Workpiece added – it is not clamped at this stage; the magnets are holding it in place!

PHOTO 48: Using dial-gauge to measure eccentricity on inner surface of brake-block ring.

PHOTO 49: Facing inside of ring using a boring bar.



"These components are now so cheap (a few pounds) that we took the view that there was no reason not to include one..."



PHOTO 50: Completed set of 7¼-inch gauge brake blocks.

PHOTO 51: Completed handle boss, prior to drilling for handle.

PHOTO 52: Drilling the hole for the handle.

PHOTO 53A: Commercially obtained thrust bearing disassembled...

PHOTO 53B: ...and once assembled.

hole should not be tapped at this stage, for reasons which will become apparent shortly.

Finally, the recess for the thrust-bearing can be added by boring out the centre hole. There are a number of ways of doing this, but using an angled V-cutter, followed by a boring bar, is perhaps the simplest (Photo 54 shows the equivalent boring operation for the bearing retainer, as an example of this process). The corners of the thrust-bearing housing are radiused, so there is no need to go overboard to achieve a sharp inner corner.

The required length can now be parted-off. At this point, it would be possible to reverse the part in the chuck and create the chamfer (or rounding, if preferred) on its upper circumference. Alternatively, you can wait until the handbrake control rod has been made, thread this into the handle boss and hold the rod in the lathe. It is easier to ensure that the boss will run true in the lathe with this arrangement (since the handle boss can be placed hard up against the jaws) making adding a consistent chamfer much easier. The completed part at this stage (and after chamfering) is shown in Photo 51.

Photo 52 shows the through-hole, to accept the handle, being drilled in the handle boss. In our case, we drilled this slightly undersize (by 0.5mm) and then reamed to the correct diameter (8mm).

Thrust-bearing

The use of a thrust-bearing is perhaps overkill on a brake column (in this scale), but we didn't want to be faced

with increased friction if applying the brakes 'hard' in an emergency. These components are now so cheap (a few pounds) that we took the view that there was no reason not to include one. The dimensions of the part we used (and which the brake-column is designed to include) are provided in Figure 39, with photos of the actual part used being shown in Photo 53.

Bearing Retainer

This sits at the top of the column and, as its name suggests, acts as the support/retainer for the underside of the thrust-bearing. Its dimensions are given in Figure 40 and it is made from the same bar-stock (rod) as the handle boss (and can even be made immediately afterwards, thereby saving a little setup time).

The part is fairly straightforward to machine in the lathe – a large (but shallow) hole is required as the starting point and we used a series of



ever-larger drills until our boring bar would just fit. We then bored out the remaining material with the boring bar (Photo 54). Photo 55 shows the completed part.

Upper-column Inner Guide

Rather than using a solid piece of steel rod for the handbrake control column, with a plus-6mm hole drilled through the middle (with a very long drill bit...), we decided to use a piece of tube for the main column and fit it with guides at the top and bottom, to centralise the brake control rod. Both guides are (ideally) made from 16mm diameter mild-steel rod, although we used a larger diameter and turned this down to the required size (as we had the material to hand). The dimensions of the upper of these two guides are provided in Figure 41.

The part is straightforward to machine (Photo 56) and, once complete, should look like Photo 57. ▶



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The stepped section is used to locate the centre of the thrust-bearing, as will be evident when the complete column is assembled.

Handbrake Column

As noted above, the column itself (Figure 42) is simply a piece of 20mm diameter steel pipe, parted to the

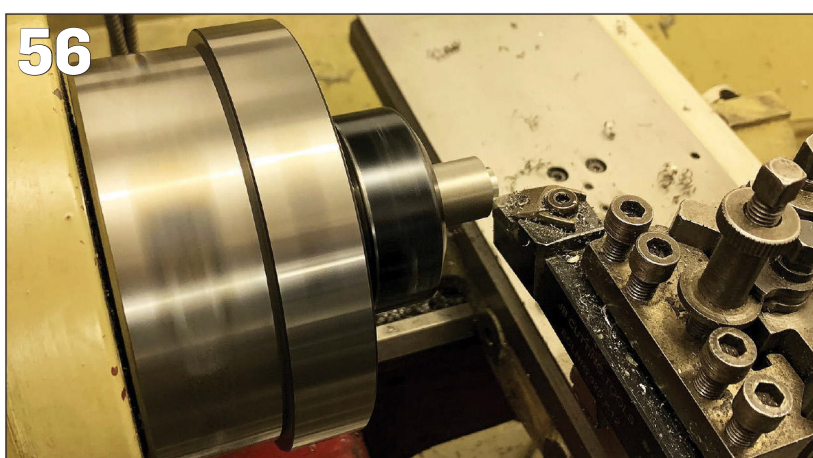


PHOTO 54:

Boring inner face of bearing housing – care taken not to force tool onto flat end-surface.

PHOTO 55:

Completed bearing-retainer (only outer surface will be seen on control column and is not a rubbing surface, so finish is not critical).

PHOTO 56:

Machining upper-column control-rod guide from mild-steel rod.

PHOTO 57:

Completed inner-guide for top of the column.

Photos and diagrams in this feature by the authors



correct length. We chose a strong thick-walled pipe (2mm wall thickness) just in case it got knocked or bumped in use (or transit). **EIM**

■ Next month Peter and Matthew complete the construction of the handbrake and its attachments.

Parts 1 to 3 of this series appeared in the November 2022 to January 2023 editions of **EIM**. Digital back issues can be downloaded or printed copies ordered from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.



LETTERS

Exhibition awards – time for a change?

Thank you for the last excellent edition of **EIM** including coverage of the recent exhibition. The results show, I believe, a flaw in the awards system. The front cover rubric admits they could all be winners!

I suggest that a different system of awards could be introduced, where the cash prizes are abolished, and joint 1st (2nd or 3rd etc) are introduced. After all, we don't make our models to make money...

I can't help comparing the way Model Engineer does its award system. If a number of models are found to be of similar excellent standard, then as many gold, silver or bronze medals are awarded irrespective of numbers. This seems a much fairer way of making awards. The outstanding model can be awarded a further accolade in the form of the Duke of Edinburgh's Award (which I hope will continue).

There would be no harm in emulating this system except that **EIM** perhaps wants to be different?

David R. Machin

Having visited the **EIM** exhibition I was admiring a very good but obviously hand-built model.

Standing next to me were two guys. On

looking at the model one said to the other, in what I thought was a rather sarcastic manner, "I could do far better than that. Punch it into the CAD and feed it into the machine, it would be far better."

I turned to him and said I could even better that. Having received a rather surprised and startled look, I said all you have to do is go online and order a model from Korea or a mass-produced one from the back woods of China. It would be perfect.

The look on their faces told me they didn't actually get my point.

Maybe we should have two categories for show awards, model makers with long acquired skills and knowledge and computer operators with fancy machines.

Some time ago I made an oscillating engine. Although I have a milling machine, I spent nearly a day with a chalked file, sheet of glass and grinding paste.

When I arrived at a steam seal the feeling of achievement was immense.

Tony Drake

The Editor replies: Thanks to David and Tony for their interesting views but both gentlemen make one erroneous assumption

– the Midlands Model Engineering Exhibition is by no means **EIM**'s show! We sponsor the event and I was honoured this year to be asked to join the judging panel, but the show is an independent event organised by Meridienne Exhibitions. Having said that the folks at Meridienne do read **EIM** so I'm sure any good ideas for future awards changes would be considered!

I think it's also worth highlighting that the number of potential winners could have been skewed this year as this was the first event in three years – three shows' worth of quality model engineering...



Making Model Steam Boats

By Stephen Bodily

A new publication from the useful series of model engineering guides produced by Crowood Press deals with a subject we don't see enough of in our pages, steam-powered model boats.

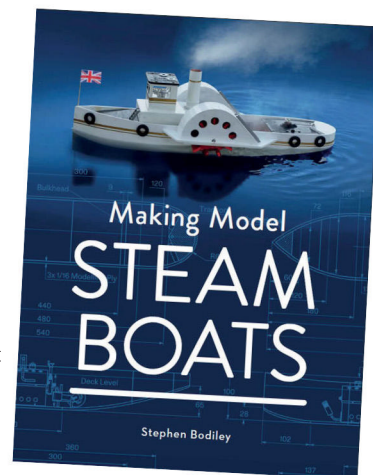
This compact but comprehensive guide runs to 176 pages and includes more than 275 colour photos and diagrams. The highly experienced author takes readers through every aspect of building a model boat, from the initial design of its steam propulsion system, to the building of the boat itself – marine subjects that may not be so familiar to many **EIM** readers such as creating the

hull shape and the propeller design.

The book is not just about theory, however. Included are plans and descriptions to enable the reader to build three types of boat, starting with a screw-driven 'pond runner' launch, moving on to a fast patrol boat and a twin-cylinder paddle steamer, as well as offering guidance on how one's boat modelling can progress.

The text is informative but highly readable and easy to understand, the photos and diagrams clear and well reproduced – follow the guidance in these pages and you'll be boating in no time... **AC**

ISBN 9780 71984 131 6 Price £19.99 Published by Crowood Press
Email: enquiries@crowood.com Web: www.crowood.com



The Gas Tramcar – an Idea Ahead of its Time

By John Hannavy

This is one of those excellent books that comes along all too occasionally, throwing a spotlight on a subject that has previously received very little in the way of coverage and something that many an **EIM** reader will likely know nothing about – certainly your reviewer had never previously heard of gas-powered trams...

Perhaps this is not surprising because as the author describes, the gas-powered tram was a short-lived phenomenon, designed to replace horses and steam on the roads. Its proponents argued that gas provided a far simpler and much less costly alternative to electricity

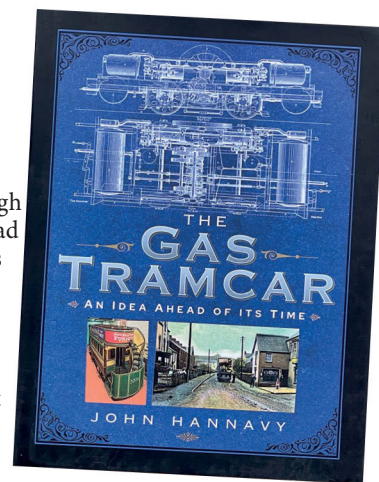
with all its extra infrastructure of overhead catenary, power generating stations and such.

It seems that for a while the concept did make progress, designs were patented and gas tram systems went into operation in

several places across the world, including in the UK, in Neath, Blackpool and Lytham. As we all know, the proponents of electricity eventually won the argument, though gas could have simply been too ahead of its time, with such power sources actively being pursued by transport operators today.

The author has certainly left no reference source unstudied in this story – the book describes the short history of the gas tramcar in detail, but more than that it takes a close study of the technology, with many excellently reproduced period photos and particularly engineering drawings which will no doubt most interest **EIM** readers. This is a fascinating book on an obscure subject. **AC**

ISBN 9781 39909 601 0 Price £35.00 Published by Pen & Sword
Email: enquiries@pen-and-sword.co.uk Web: www.pen-and-sword.co.uk



Gresley's Silver Link – Evolution of the A4 Pacifics

By Tim Hillier-Graves & Ronald Hillier

Pen & Sword's rapidly expanding reference library profiling major British steam locomotive classes now encompasses one of the most iconic of all with this superb new offering focusing on the Gresley A4 Pacifics, fastest and most-admired engines of their time.

Well we say this is a book on the A4s – you don't actually see an example of the so recognisable streamlined locomotives until after 140 of the book's 240 pages. The evolution part of the title is very relevant, the authors spending much time and detail describing how designer Sir Nigel Gresley progressed through his earlier designs in his constant search for the fastest, most powerful locos. And the

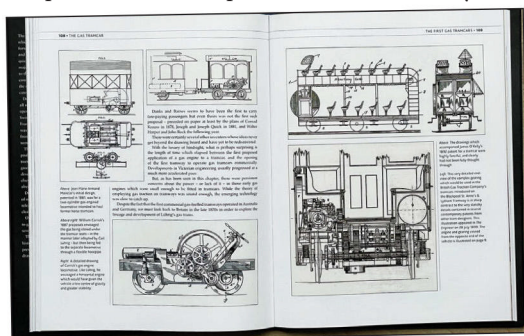
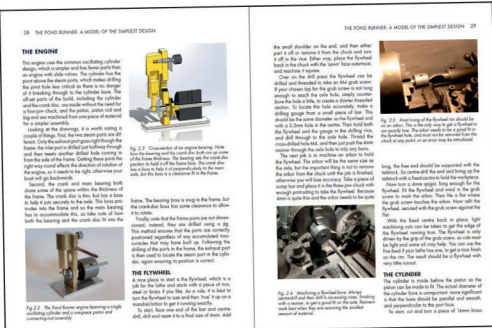
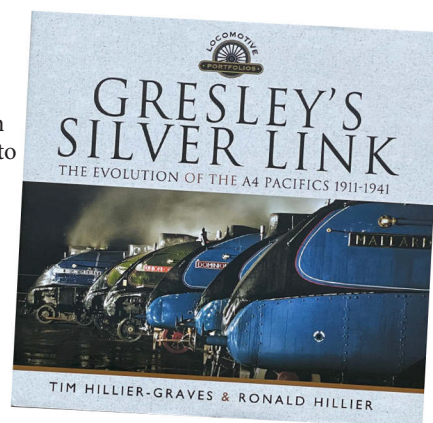
study goes outside the UK too, looking at streamlined locos on the continent that contributed to Gresley's thinking.

Design and construction of the first A4, 'Silver Link' is documented with several interesting detail photos and engineering drawings, and again the description extends beyond the locomotives to the streamlined, luxury carriages that were created to run with them.

The story ends with the start of the Second World War and Gresley's passing in 1941, by which time he had seen his locomotives take many glories including that famous record for 'Mallard'.

Packed with information and quality illustrations used large whenever possible, this is a must-buy for A4 fans and will also find interest among all those who like large locomotives. **AC**

ISBN 9781 39907 339 4 Price £35.00 Published by Pen & Sword
Email: enquiries@pen-and-sword.co.uk Web: www.pen-and-sword.co.uk





ABOVE: The enormous and always busy Gauge 1 layout with live-steam locos in action is a perennial highlight of the Midlands Garden Rail show.
Photo: Meridienne Events

BELOW: This superb Gauge 1 model of the LNER experimental 'Hush Hush' Pacific locomotive was part of the Bromsgrove SME stand at the 2022 Garden Rail show.
Photo: John Arrowsmith



Garden rail show readies for return



First of the traditional shows to return following the Covid pandemic last Spring was the one aimed at the smaller end of our hobby, the Midlands Garden Rail Show, and organisers Meridienne Events are now looking forward to this year's version of the event on 11th-12th March, which they hope with the return of a closer to normal life will be even bigger and better than last year's.

The show, jointly sponsored by **EIM** and our sister magazine *GardenRail*, features the 'garden scales' of O Gauge, G Scale, Gauge 1, 16mm and such like. It is held at the Warwickshire Exhibition Centre, which is on the junction of the A425 and B4455 near Leamington Spa, postcode CV31 1XN.

While many of those working in the garden scales consider themselves modellers rather than model engineers, there is always an interesting crossover between the two with plenty of model engineering content among the attractions on offer. For example among the confirmed attendees with stands at this year's event are the National 2½" Gauge Association and the Bromsgrove and Coventry Model Engineering Societies.

Around a dozen layouts have been confirmed for the show, in O, G and 16mm scales and Gauges 1 and 3, running electric alongside gas and coal-fired live steam.

In addition more than 30 leading suppliers will also be at the show promising to provide everything a visitor might need to create their own garden railway, including locomotives, rolling stock, track and accessories.

The show is open between 10am and 4pm on each of the two days, with tickets costing £10 for adults, £9.50 senior citizens and £4.50 for accompanied children aged between five and 14 years.

More details are available on the website at www.midlandsgardenrailshow.co.uk – the site also includes advance ticket booking facilities. And as usual we will be carrying a report on the show after the event.

Harrogate show is go in March

The return of the Harrogate Model Engineering Show has been confirmed – as reported in last month's **EIM** the event is scheduled to take place in the exhibition halls of the Yorkshire Event Centre at the Great Yorkshire Showground on 10th-11th March.

The dates are unusually a Friday and Saturday (the second unfortunately clashing with the Midlands Garden Rail Show detailed above) and the show will be a combined event alongside the long-established Harrogate Model Rail model railway exhibition.

Unfortunately we still cannot give you much detail on the model engineering content of the show – the event's website, www.theeventsoffice.com states that it will cover all the major spheres of interest including rail, marine, traction engines and more than 100 club and trade stands, while the model railway side will include the 200ft long O-gauge layout 'Heaton Lodge'.

The site states that it will be updated with more details closer to the event and offers discounted early ticket booking – ticket prices on the gate will be £15 adults, £1 accompanied under 16s, with tickets offering access to both shows.

We hope to bring you more details next month.

New era set to begin for Polly

A new era is set to begin in 2023 for Polly Model Engineering – the Nottingham-based firm renowned for its locomotive kits and a major supplier to the hobby.

The firm announced in mid December that it will be passing into new ownership, current directors Andy and Jayne Clarke having retired, joining Professor Pete Thomas who retired from the business 18 months ago.

According to the firm's website Polly will be relocating to new premises that will be more appropriate to the continuing business. We will bring readers more details when we get them but meantime Polly is still contactable for any model engineering needs on 0115 973 6700 or sales@pollymodelengineering.co.uk

Calling all model engineering manufacturers and suppliers

We want your latest news!

If you are launching a new product or have any news to impart that will be of interest to our readers, then space is available on this page.

Please send details, and pictures, to editor@engineeringinminiature.co.uk

Experience the key to track success

Seasonal trains kept many a club busy this winter but some tracks will not see trains again, with a skills shortage possibly building up future problems...

COMPILED BY ANDREW CHARMAN

Welcome to this month's club and track news round-up and we start firmly in the commercial track sector this month, and as mentioned briefly in my page 3 editorial some thoughts on the 'state of play' of the miniature railway market. These stem from pictures sent to me by my son and a visit I made in November in my role as editor of EIM's sister magazine, *Narrow Gauge World*, to renowned narrow-gauge and miniature railway engineers Alan Keef Ltd – a couple of photos from the Alan Keef workshops appeared in last month's issue.

My thoughts were galvanised by a post-Christmas visit by son James to Marwell zoo, near Southampton, a regular day out for him, his wife Sophie and our grandson Charlie – he's almost three years old and already obsessed with trains (properly educated you see...).

James sent me over the pictures at right which show the trackbed of the former 15-inch gauge line that ran at the zoo, first opened in 1987. "I wasn't surprised to see this," he said. "The train hasn't run since the end of Covid and talking to one of the staff earlier in the year it sounded like it was unlikely to. But it's pretty difficult dealing with a three-year old who can't understand where the train tracks he's seen before have gone..."

I was immediately reminded of the conversation I'd had a few weeks earlier with Alan Keef managing director Patrick Keef and his sister Alice Basey, the company's Finance director and also head of its trackwork ▶

TOP RIGHT: Where once there was a railway – all that remains of the former 15-inch gauge line at Marwell Zoo.

Photos: James Charman

RIGHT: In contrast, the epitome of a well-run, fascinating miniature railway. If you haven't visited the 15-inch gauge Perrygrove Railway, at Coleford in the Forest of Dean, then you really should. It offers an excellent ride in a compact site with sharp curves, challenging gradients – if 'minimum gauge' estate railway pioneer Arthur Heywood were alive today, he would certainly be a fan of this line.... *Tim Edmonds* visited at the end of the main season on 27th October. The steam loco 'Lydia' in the lower picture was built in 2008 by Alan Keef Ltd, which gets rather a mention in these pages this month...





"Once a staff member who had an interest in the railway departs for any reason, the keenness to run the line goes with them..."

team. You see while AKL, which celebrated its 50th anniversary in 2022, is renowned in the narrow gauge arena for its locomotives and its heritage projects such as new-builds for the likes of the Corris and Lynton & Barnstaple railways, one of the most important aspects of the firm's work these days is what is described as the leisure market – building and maintaining 'park railways'.

Under-appreciated

Alice believes that such lines go almost unnoticed in the wider railway scene, but should not be under-estimated. She quotes the remarkable example of the 10¼-inch gauge Audley End Railway in Essex, which has previously had new carriage sets built for it by AKL. In 2021 the railway carried more

than 154,000 passengers, while its Santa Special trains run across the whole of December, involve something like 800 train movements and always sell out. Those are the kind of traffic figures that many a heritage railway would be absolutely delighted with, and some would be probably unable to cope with....

So is it all sweetness and light in the park railway market? Not necessarily, it seems, because while it has grown "out of all proportion" in recent years, the railways today are in many cases being operated by people with limited skill sets and facilities. Alan Keef Ltd's maintenance crews find themselves spending longer at each site they go to, because they are having to do tasks that would previously have been carried out by an

on-site fitter. "We have to do stuff like changing brake blocks on stock, which we never used to," Alice says.

So it seems there is a skills shortage among miniature and park line operators – once a staff member who had an interest in the railway departs for any reason, the keenness to run the line often goes with them and can lead to the likes of what has happened at Marwell.

So what has all this to do with us, model engineers, at clubs where there is no lack of skills or enthusiasm? Well in this correspondent's view, it's yet another reason why we should be trying to attract new, young members to our clubs, to build a next generation of enthusiastic engineers who might want to get involved with such jobs as running railway.

It's my, possibly controversial, view that we missed a generation, several years when the rise of computers and such vocational subjects drew people away from an interest in hands-on engineering subjects. I also think that traditional engineering is now fighting back, judging by the enthusiastic youngsters I meet at shows and clubs, but that these are perhaps the people that will fill tomorrow's mechanical engineering needs, not today's?

Plugging in

Enough, I'll get off my soapbox now. Interestingly James wondered to me if the Marwell line's demise had anything to do with visitors not wanting to see "dirty diesels" pulling trains in today's greener environment. That could possibly be a factor – at Alan Keef they also told me they have never had so many enquiries for battery-electric locos, which as well as meeting emissions concerns are of course quick to get going and simple to operate. AKL is very experienced in supplying such locos, previously to industry – a real case of full-size following model!

My long diatribe above is partly accounted for by a much smaller number of club journals than is usual dropping into the EIM editorial inbox since the last issue. Clearly in December there were other priorities! We anticipate this to be only a temporary hiccup and we expect there will be a bumper influx before I come to fill these pages next month. But if you are a member of a club, that publishes a journal and you never read anything about your club in these pages, it's likely because I don't see that journal! Perhaps a word in the ear of the editor?

As ever, stories and pictures (especially pictures!) for these pages are always very welcome, while the journals not only provide copy for *Club News*, they also give us an

ABOVE LEFT:

Stockholes Farm railway owner Ivan Smith doesn't miss the chance for some after-dark running...

BELOW: ...or making the most of preparing for a boiler test!
Photos: SFMR



excellent idea of what is interesting model engineers, helping us to more effectively plan our future issues...

One line your editor has had on his bucket list for some time and definitely intends to do something about finally visiting this year is at Stockholes Farm in north Lincolnshire, just off junction 2 of the M180 near Doncaster.

The **Stockholes Farm Miniature Railway** is a private 7¼-inch gauge line run by Ivan and Barbara Smith at the head of a team of volunteers. In the past it has staged open days during the year (in 2022 they were for members only) and is a complex setup boasting gradients, bridges, a tunnel – take a look on Google Maps for a clear indication...

Ivan publishes a regular newsheet keeping members up to date with latest goings-on, as there is always something happening. The latest reflects a situation we are all experiencing, the increasing difficulty of getting the coal supplies we have all been used to. “This situation is only going to get worse,” Ivan commented.

The night train

Rather more fun was to be had on bonfire night – a Saturday this year, with members present but daytime activity ruined by persistent rain. It only abated in the evening so as the picture above left shows, it seemed an excellent excuse for some after-dark running to watch the fireworks displays staged by local residents. We like those who don't stop playing trains just because it gets dark...

The other shot from Stockholes, at left, is even more atmospheric. The line is generally LMS-themed and the fleet includes a couple of ‘Duchess’ Pacifics. One, ‘Duchess of Atholl’

ABOVE RIGHT:

Happy visitors at the Rugby ME's sold-out Santa train event, which even the weather could not dampen the enthusiasm for!

BELOW RIGHT:

Latest work going on at Rugby includes a new building and adding yet more track flexibility.

Photos: Howard Brewer/Rugby ME

BELOW:

No shortage of power, despite the small proportions... Ben Pavier's 2½-inch gauge LBSC ‘Fayette’ during a visit to Southport's Small Gauges Day in September.

Photo: Nz1/2GA



needed to be steamed up in preparation for its boiler test – well that was Ivan's excuse. He did try a pack of processed smokeless fuel to see how it would react in the firebox but admitted that most of the three hours that he ran were “playing...”

More evidence too of that return to normality, with the latest edition of the *Link* from the **City of Oxford SME** reporting that the club's public running season produced more than 7,000 more passengers than in 2021, and that still with two Christmas runs to be added to the total...

Chairman Denis Mulford then adds a comment that is very pertinent and perhaps often forgotten by some members of model engineering clubs; “Do remember that the passenger takings pay for all the projects that we do on the tracks and site with the subscriptions paying for only a small portion of our expenditure.”

Super Santa

Keeping an eye on various social media feeds, as your editor does, has

revealed in recent weeks that many clubs have been able to stage proper festive Santa train programmes this year, mostly for the first time since 2019, and they have proven very successful, local visitors enjoying the opportunity of a wintry day out.

Typical of these were those ever busy souls at the **Rugby ME**, who staged two days of Santa trains at their Rainsbrook Valley Railway in December and sold every ticket a week before the event. This was fortunate, as writing in the club newsletter editor Howard Brewer commented; “Saturday was cold and frosty but the Sunday was cold and very wet... in 12-plus years with the club the Sunday was the worst weather I have ever encountered for public running...”

Aside from highly successful public events Rugby members have been busy improving their facilities – making rapid progress is the new facilities building, which was receiving its roof trusses in December, and those working on it had a good view of a new ‘loop siding’ that another group of





members were adding to the ground-level running line.

It's not been all good, however. At the end of November an unwelcome night-time visitor in the form of a Mercedes-Benz crashed through and demolished part of the club's perimeter fence and came close to falling into a cutting onto the track. Club members had to mobilise themselves rapidly, forming an overnight work party to rebuild the fence and make the site secure again.

Such incidents aside, the December newsletter includes a look-back of the activities over the last 12 months at Rugby, which really brings home just how much gets done at this club in an average year!

Small but mighty

We always look forward to a new edition of *Steam Chest*, the journal of the **National 2½"-Gauge Association**. The smaller scales seem to be less popular than the 'standard-bearer' 5 and 7¼-inch gauges, but are just as relevant and can provide just as much enjoyment for their exponents. Pictures in the latest *Steam Chest*, one reproduced on the previous page, show that these seemingly tiny locomotives can nonetheless offer plenty of pulling power!

Good to see that 2½-inch is not just about running older engines – the journal also includes a superb, deep blue A1 Pacific loco, which has been built by Association member Tom Barnes and is very close to completion – perhaps he could be persuaded to describe its building for our readers...

Members of the Association are also discussing the looming coal crisis, with a potential alternative being gas – practical perhaps in this scale but not the larger gauges... **EIM**

■ And finally, winter action in Vienna. Since opening in 1928, the city's celebrated 15-inch gauge Liliputbahn in the Prater has usually closed for the winter (writes **Donald Brooks**). This year was different, however – the railway's main station lies in the shadow of the Big Wheel, famous for its appearance in the 1949 film *The Third Man*. The area below it hosts an array of food and drink stalls from mid-November through Christmas and into the New Year and for the first time the Liliputbahn ran trains to coincide with it.

The railway was timetabled to run on Fridays, Saturdays and Sundays between 19th November and 8th January. Operations were weather dependent – when I visited on Friday 25th November there were clear blue skies, sunshine and temperatures in double figures.

The railway is a 3.9km elongated circuit which for most of its distance looks like a double-track line with return loops at both ends. Trains normally run anticlockwise over the full route but with a half-hourly service in force, they followed the outbound track from Prater Hauptbahnhof to Stadion where, instead of continuing round the loop, they reversed and used the outbound route to return to Hauptbahnhof.

This operation unusually meant having a loco at each end of the train with bo-bo D4, built in Vienna by Tobisch in 1967, at the Stadion end and the line's original 1957 diesel Bo 2 D1, also built in Vienna but by Gebus, at the Hauptbahnhof end.

With passengers thin on the ground, it remains to be seen whether this experiment will be repeated in future years.

NOTICE BOARD

Notice Board is a free service that readers are welcome to take advantage of. If you have something for private sale, are searching for that elusive casting or drawing, or just want to alert your fellow model engineers to something of potential interest to them, then send in details to the address on page 3, marked 'Notice Board' and we'll put it in!

FREE TO A GOOD HOME: I have a collection of *Model Engineer* magazines more or less complete from 1986 and a lot of copies before that date. I also have copies of *Engineering in Miniature* dating from 2003 which are also more or less complete. They are not bound but are in cardboard file boxes. Free to a good home but will have to be collected from near Brackley in Northamptonshire.

John Roberts: johnpimlico@house@gmail.com

DIARY

EVERY SUNDAY

North Wilts ME public running, Coate Water Miniature Railway, Swindon SN3 6AA 11am-dusk,

FEBRUARY

- 1 Bradford ME meeting, subject tba, Saltaire Methodist Church, 7.30pm
- 1 Lincoln ME meeting, talk by Jim Bailey, The Stone Arms, High St, Skellingthorpe LN6 5TS, 7.30pm
- 3 Brighton & Hove SLME meeting, Bits & Pieces Evening, West Blatchington Windmill, BN3 7LH 7.30pm
- 4 Rochdale SME meeting, Darkhill Ironworks by Bob Hayter, Castleton Community Centre, Manchester Road, Rochdale, 7pm
- 5 Bristol ME meeting, Modelu scale model figures and details, Begbrook Social Club, BS16 1HY, 7pm for 7.30pm – details from secretary@bristolmodelengineers.co.uk
- 5 Guildford ME Small Model Steam Engine Group open meeting, Stoke Park, Guildford, Surrey, 2-5pm
- 7 City of Oxford SME meeting, Measuring in space by Graham Toplis, Cutterslowe Pk, Oxford
- 9 Worthing SME meeting, subject tba, Field Pce, Worthing, Sussex, BN13 1NP 7.30pm
- 10 Hereford SME meeting, Steve Turner gets gossiping about two old ladies, Broomy Hill, Hereford HR4 0LJ, 7pm for 7.30pm
- 12 Southampton SME running, Riverside Pk Rly, Bitterne, SO18 1PQ, 11am-3pm
- 14 Romney Marsh ME Members' Social Afternoon, Rolfe Lane, New Romney, from 2pm
- 17 Brighton & Hove SLME meeting, Films with Keith Carter, West Blatchington Wndml, BN3 7LH 7.30pm
- 18 Rochdale SME auction night, Castleton Community Centre, Manchester Road, Rochdale, 7pm
- 18 Sydney LSLs running, Anthony Rd, West Ryde, NSW, Australia
- 21 Romney Marsh ME meeting, progress on the Brighton Atlantic by David Jones, Rolfe Lane, New Romney, 7.30pm

- 23** Worthing SME meeting, club AGM, Field Pce, Worthing, Sussex, BN13 1NP 7.30pm
- 25** Teeside SMG Members steam-up, Preston Hall Museum, nr Stockton, <http://tsgr.co.uk>
- 26** Southampton SME running, Riverside Pk Rly, Bitterne, SO18 1PQ, 11am-3pm
- 28** Romney Marsh ME Members' Social Afternoon, Rolfe Ln, New Romney, 2pm
- 1 MARCH**
Bradford ME Annual General Meeting, Saltaire Methodist Church, 7.30pm
- 1** Lincoln ME meeting, Bits & Pieces, The Stone Arms, High St, Skellingthorpe LN6 5TS, 7.30pm
- 3** Brighton & Hove SLME meeting, Members Evening, West Blatchington Wndml, BN3 7LH 7.30pm
- 4** Rochdale SME general meeting, Castleton Community Centre, Manchester Road, Rochdale, 7pm
- 7** City of Oxford SME meeting, Alternative Hobbies night, Cutterslowe Pk, Oxford
- 9** Romney Marsh ME meeting, overhauling RH&DR locos by Andy Blackwell, Rolfe Lane, New Romney, 7.30pm
- 10** Harrogate Model Engineering Show
- 11** and Model Rail 2023, Yorkshire Event Centre, Great Yorkshire Showground, Harrogate HG2 8NZ. 10am-5pm each day. Details at www.theeventsoffice.com
- 11** Midlands Garden Rail Show,
- 12** Warwickshire Exhibition Centre, 10am-4pm each day. More details at www.midlandsgardenrailshow.co.uk
- 14** Romney Marsh ME Members' Social A'noon, Rolfe Ln, New Romney, 2pm
- 15** Bristol ME meeting, The Camerton Line, Begbrook Social Club, BS16 1HY, 7pm for 7.30pm – secretary@bristolmodelengineers.co.uk
- 17** Brighton & Hove SLME meeting, The Atlantic Project - update by Fred Bailey, West Blatchington Wndml, BN3 7LH 7.30pm
- 18** Sydney LSLs running, Anthony Rd, West Ryde, NSW, Australia
- 21** Romney Marsh ME meeting, products of the winter workshop, Rolfe Lane, New Romney, 7.30pm
- 25** Federation of Model Engineering Societies Annual General Meeting, National coal mining Museum, Overton, Wakefield, West Yorks, 12.30pm
- 25** Romney Marsh ME boiler testing Rolfe Ln, New Romney, 9am-noon, running from noon
- 25** Teeside SMG Members steam-up, Preston Hall Museum, nr Stockton, <http://tsgr.co.uk>
- 26** Bristol ME public running, Ashton Court Railway, BS8 3PX, noon to 5pm
- 26** Guildford ME public running, Stoke Park Railway, London Rd, Guildford, Surrey GU1 1TU, 2-5pm
- 26** Romney Marsh ME track meeting, Rolfe Ln, New Romney, Kent, from noon

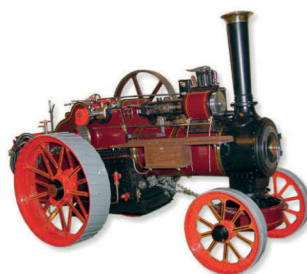
PLEASE NOTE all outside events and public running subject to weather – please check with Society concerned before travelling to an event.

Details for inclusion in this diary must be received at the editorial office (see page 3) at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of every event being held. Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions in these listings, or subsequent cancellations of events.

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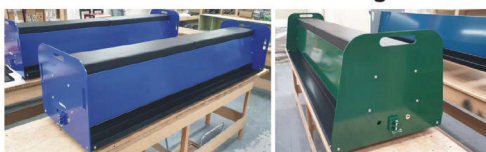


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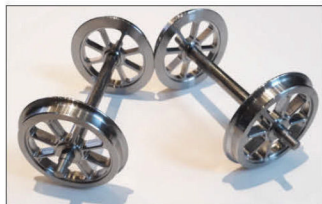
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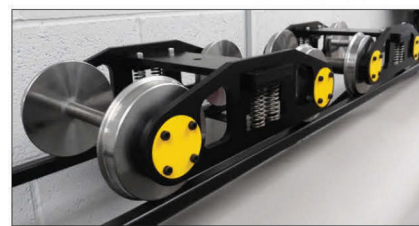
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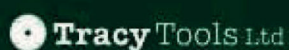


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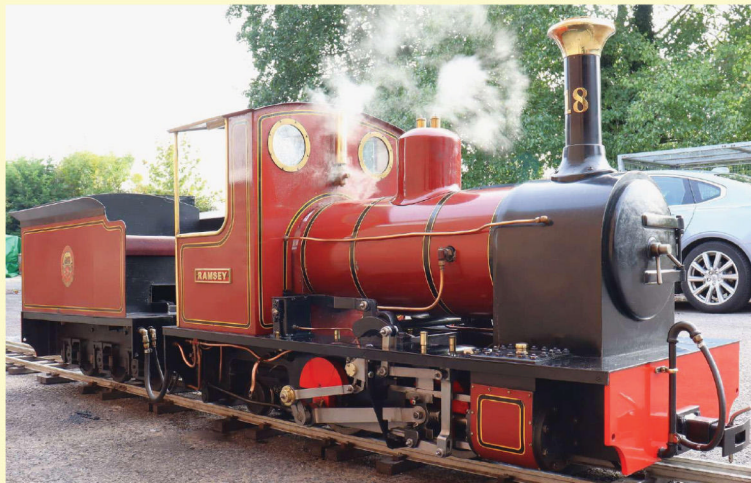
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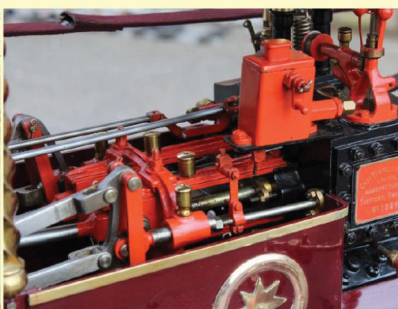
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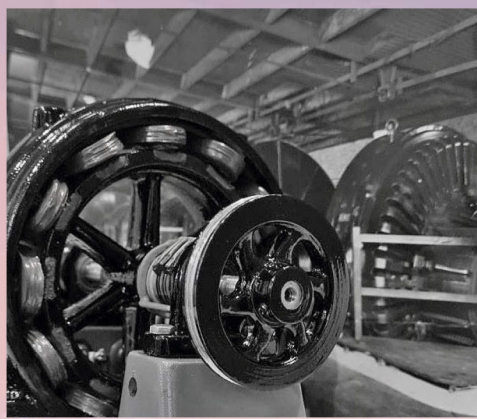
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