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CONTENTS

MARCH 2023 Volume 44 Number 9

THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING
in Miniature



06 7 1/4-INCH GAUGE RIDE-ON TENDER PROJECT

by Peter & Matthew Kenington

11 AN INSIGHT INTO MINIATURE INJECTORS

by Roy Preston

14 CONWAY: NOVICE GUIDE TO LOCO BUILDING

by Rich Wightman

17 BUILDING A 7-INCH FOWLER STEAM LORRY

by Martin Johnson

24 THE SEARCH FOR FUTURE COAL

by Edward Parrott

29 IMPROVED SCHOOLS - BUILDING A ROEDEAN

by Nick Feast

31 TIPS FOR MODEL ENGINEERS - PARTING

by Harry Billmore

32 LOCOMOTIVES - GOING ROUND THE BEND

by Warwick Allison

34 HARRY'S GAME - A STRANGE START

by Harry Billmore

38 LETTERS & REVIEWS

39 GENERAL NEWS

40 CLUB & TRACK NEWS

44 CLUB DIARY

FRONT COVER

Some 13 years of effort rewarded as Martin Johnson's 7-inch scale Fowler Steam Lorry project moves under its own steam for the first time. Martin updates his long-term build story in this issue. *Photo: P J Johnson*



EDITORIAL

Enthusied by time and motion

Welcome to the March issue of **EIM** – as I pen this month's editorial missive it's actually the end of that perennially depressing month of January, but I've had a surprisingly interesting time over the past few days putting together one of my Christmas gifts, a laser-cut wooden model of a pendulum clock.



These kits, which one can find in such venues as large garden centres and which range from sensible things like clocks to ball-bearing runs, locomotive models and even representations of cameras, have become popular in recent times. The very fine finish provided by today's laser-cutting machines produces kits that are not difficult to put together for the novice, but complex enough to be interesting for such as the typical **EIM** reader who would normally be spending such time in the workshop – at least making one of these is a family-friendly activity!

We are seeing more of these 'activity gifts', a very good thing as it persuades people that making things is fun, rather than spending all day shooting things on a computer screen. I must admit I rather like my completed clock – watching the pendulum motion is therapeutic and it even has a proper 'tick' sound. What I'd like to do now is make one in metal, but I'd never have time or likely the skill for proper clockmaking such as do some **EIM** readers, making gears and such. Why doesn't anyone make such kits in metal – or do they?

March brings a welcome day out with another model engineering show, this time at Harrogate. We were a little sceptical when this was first announced, thanks basically to a lack of information from the organisers, but now courtesy of the show website we have a list of clubs exhibiting and traders that confirm that it should be a good event – I'm looking forward to a trip north. It's a shame it's over the same weekend as the **EIM**-sponsored event for the smaller garden scales, the Midlands Garden Rail Show, but at least Harrogate is on the Friday and Saturday, the Midlands on the Saturday and Sunday, so the bolder among us should be able to do both over the weekend! More details of both events are on page 39.

Andrew Charman – Editor

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Building a ride-on tender from scratch

Peter and Matthew continue to build their 'beginners' project 7¼-inch gauge ride-on tender, this month completing the handbrake mechanism and its attachments.

BY PETER AND MATTHEW KENINGTON Part Five of 11

Last time in our ride-on tender build project we made most of the braking system, including the brake blocks and much of the handbrake operating hardware, and we complete these parts this month.

Handbrake control rod

The handbrake control rod is made from a piece of 6mm diameter silver-steel rod, to the dimensions shown in **Figure 44**. The only machining required is the small reduction in diameter just above the lower threaded section of the rod. This will ultimately accommodate an E-clip which prevents the rod from being removed or forced upwards in use (when releasing the brakes, for example). Both threading operations were undertaken with the rod mounted in the lathe chuck, although this is not essential.

Using a parting-off tool on a long section of rod (to cut the recess for the e-clip) posed a slight challenge, as the rod was relatively thin. We could have used a live-centre, however we felt that the rod may still have had a tendency to bend during the operation. Ideally, we would have a tailstock-mounted live chuck (such things do exist – one is on our 'wanted' list – but we don't currently have that luxury).

The option we used instead was a 'poor-man's' version of the same thing, in other words using a Jacobs as a guide, to prevent the part from deflecting when the parting-off tool is

PHOTO 58:

Grooving the handbrake control rod

PHOTO 59:

Checking thread on boss and control rod – photo shows 'wrong end' of control rod in relation to boss, portion which will thread into cam's pivot nut.

PHOTO 60:

Widening centre-hole with 19mm blacksmith's bit.

PHOTO 61:

Narrower upper section of the part can then be turned and the corner bevelled.

PHOTO 62:

Once parted-off, part can be reversed in chuck and centre hole bored to the correct (20mm) inner diameter.

applied (**Photo 58**). The jaws should be loose around the part and some lubricant applied to prevent wear.

A low rotational speed should also be used on the lathe, although this is advisable anyway when using a parting-off tool. Needless to say, this is a bit of a 'bodge' and is not to be recommended generally (not least because regular use would wear the chuck's jaws, probably unevenly, hence compromising some of the precision of the chuck). A tailstock live chuck is definitely moving up the 'wanted' list.

We could have cut the piece to length and mounted the shorter (lower) section sticking out from the chuck, then cut the recess (with the free end unsupported). There is still a danger, however, of the rod deflecting and bending severely whilst also breaking the tool (we've been there, admittedly with slightly thinner rods). So we chose what we thought was a safer option.

The threads can be checked with the handle-boss (**Photo 59**) or simply by running an M6 nut along them.

Column-base support ring

This was machined from a 40mm diameter piece of mild-steel rod, to the dimensions shown in **Figure 45**. The outer diameter is not critical, so 'cleaning-up' the 40mm rod in the lathe (and thereby reducing its diameter to more like 39.5mm, say) is not an issue.

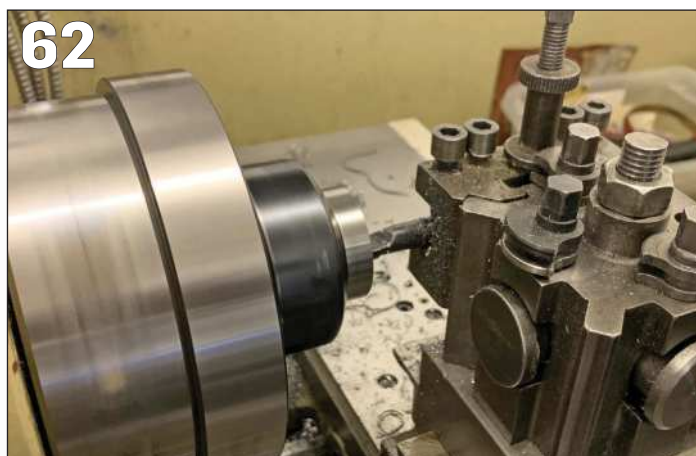


The first step is to drill the centre-hole. We started with the largest size of centre-drill which would fit into our Jacobs chuck and then drilled out the hole to 13mm with a conventional twist-drill. A set of blacksmith's drills is then required to widen this further (**Photo 60**), first to 16mm and then 19mm – blacksmith's drills are not (to our knowledge) designed to drill to their full diameter from scratch, they should only be used to increase a pre-existing hole by 2 or 3mm at a time.

The outside of the part can then be turned to the required shape (**Photo 61**). The external dimensions are not critical – it is more important to achieve a good finish as this part will be visible on the completed tender.

Photo 62 shows the boring operation to widen the hole to the 20mm diameter required to suit the pipe used for the column. Note the change of chuck, here, to a collet chuck – this both enables the part to





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

FIGURE 44 →
Handbrake control rod
(drawn half full-size)

be squared-up accurately against the face of the collet and minimises the chances of the chuck marking the outer surface of our nicely-machined (and visually attractive) part.

It would, of course, have been possible to undertake the boring operation prior to the component being parted-off (and this would have been the sensible option, if high precision was required for this part). To do this, the centre-hole would need to be drilled a little deeper, to minimise the chances of the boring bar catching on the inner end of the drilled hole (a thin bar was needed for such a small, in boring terms, hole). Drilling a deeper hole would have wasted a little material – a relatively minor amount, however, so in the end it boils down to personal preference.

Column-base inner guide

The column-base inner guide fulfils two functions: as its name suggests, it acts as a guide for the brake control-rod, ensuring it doesn't deflect when

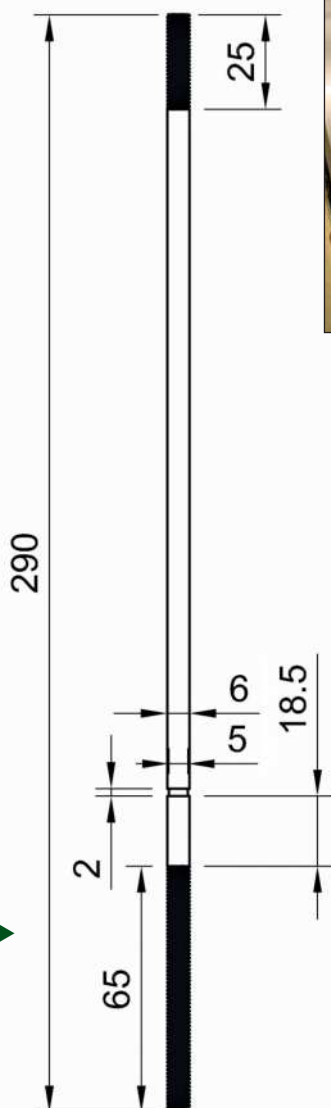


FIGURE 46 ↓
Control rod guide
(fitted to lower part of
handbrake column)

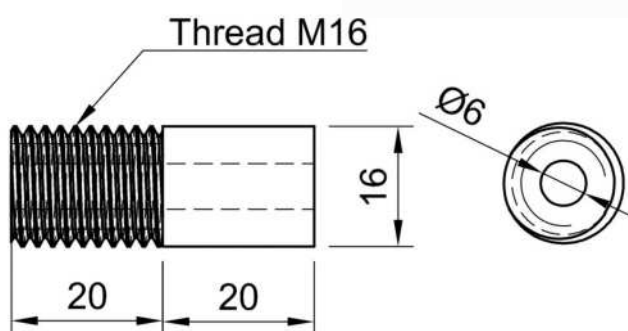


FIGURE 45
Column base support ring

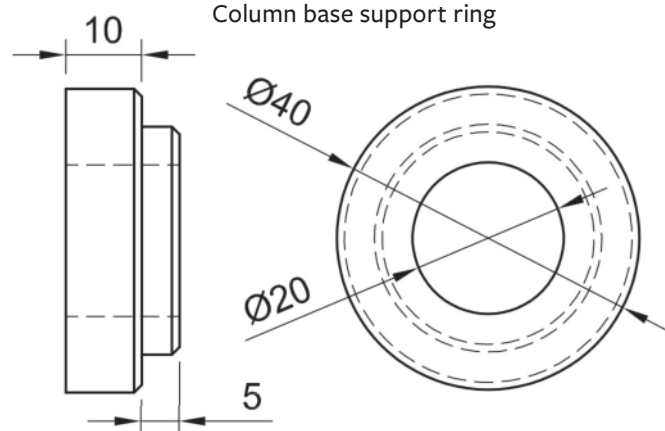
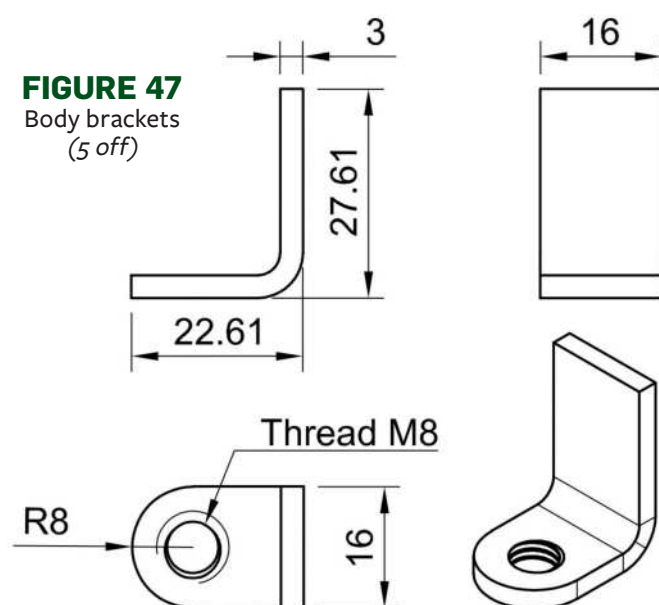


FIGURE 47
Body brackets
(5 off)



63



the brakes are applied or removed; it also acts as the attachment mechanism for the whole of the handbrake column, to the base-plate. It does this by means of the M16 thread on its base, with a corresponding nut clamping the column to the baseplate. This will be discussed in more detail later in the series.

The part was made from a piece of mild-steel rod, to the dimensions provided in **Figure 46**. We turned 4mm off the diameter of a piece of 20mm rod we had lying around, but using a piece of 16mm rod would obviously have saved some time. The M16 thread was cut with a die, as we have one, although we could have used the screw-cutting functionality of the lathe. The finished part is shown in **Photo 63** – note that the finish is not especially critical as none of it will be seen on the completed tender.

Handbrake Control Column Assembly

Assembly of the column is fairly straightforward. The top and bottom inner-guides are installed first (**Photo 64-65**), but are not welded at this stage. The column base can then be added – since this needs to be square on the column, a little care is needed here. The technique we employed was to use a small section of brass tube we had lying around to initially seat the base onto the column (**Photo 66**) and to then use the flange nut, which will ultimately hold the column in place, to gently force the base up the column until it was flush with the bottom of the tube (**Photo 67**). This should result in something looking like **Photo 68**.

The base can then be TIG-welded. There is no need to use filler and no need to form a complete weld all around the base. The only forces

64



PHOTO 63:

Completed column-base inner guide.

PHOTO 64:

Inserting the column-base inner guide – a firm tap with a hammer should be all required.

PHOTO 65:

Bottom guide installed – the thread (M16) is used to attach the column to the baseplate.

PHOTO 66:

Adding the handbrake column base.

PHOTO 67:

Using an M16 flange nut to ensure that the base goes on square.

which the weld needs to withstand are:
1) The force on the M16-threaded section which will attempt to pull the lower guide out of the tube. The welds between the tube and this part therefore need to be reasonably strong.
2) Forces on the column base ring attempting to prise it up the column, if the handbrake column is forced sideways, either in use or through accidental damage. This is likely to be a lesser force/issue.

We used four decent tack-welds, equally-spaced around the base (the underneath of the base ring, as this part will not be seen once the handbrake control has been installed on the tender's baseplate).

The omission of filler material is advantageous, as it helps to minimise the amount of 'cleaning-up' required, once the welds are complete. It is necessary to remove any weld which is not flush with, or recessed into, the column and base-ring, to ensure that the base will sit flush to the baseplate of the tender. We were a bit nervous about how this process would turn out, but in the end, it proved surprisingly easy – the omission of filler probably being the key realisation in this outcome.

We could, of course, have used some form of mechanical fixing, through the side of the base-ring and column and into the bottom-guide (for example three or four bolts or grub-screws), but we felt that these would detract from the overall

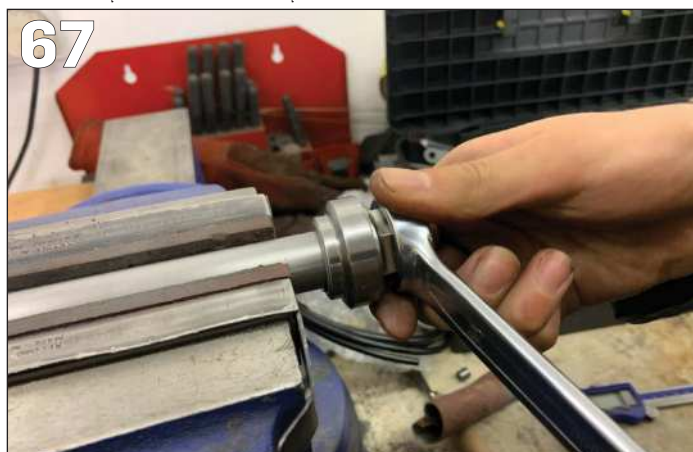
65



66



67



68



appearance of the column and so opted to try a TIG-welding approach instead. Our bravery was rewarded with a good outcome!

The welds on the base of the handbrake control can be cleaned up in the lathe, so long as the bearing retainer has not been fitted to the upper part of the column (and even then, it might be possible on some larger lathes, with an appropriate internal bore in both the chuck and the headstock).

Adding the handle

The handle is inserted into the hole in the handle boss and moved to the correct position/orientation, before the 5mm hole in the boss is used as a guide to drill through the handle (also to 5mm). This hole (including the handle) can then be tapped to M6, with the brake-control rod then being used to retain the handle.

It may be helpful to temporarily Loctite the handle in the correct position, prior to drilling and tapping the hole, depending upon how secure the 'fit' of the handle into the handle boss proves to be. As we used ground silver steel for the handle and reamed the handle hole, our fit was sufficiently secure without having to resort to glue.

The brake-control rod is screwed into both the handle and handle boss and retained with Loctite on the threads. The use of a thrust-bearing means that there should never be a large rotational moment on this part and hence using Loctite as a retainer should be more than adequate, with little chance of the handle boss unscrewing from the brake-control rod in use.

The bearing retainer can now be fitted to the upper part of the column and both it and the upper-column inner guide can be welded. Again a few small tack-welds are sufficient, without filler, all on the inner (non-visible) parts of the column. Don't forget to ensure that the bearing retainer is square to the column before welding. Once the welds have been cleaned-up (if necessary), the bearing

can be fitted (Photo 69) and the whole column assembled.

An e-clip is used to ensure that the column can't disassemble, either in transit or in use. This is fitted to the lower part of the brake-control rod in the small narrowed section of the rod. A suitable number of washers can be used to ensure that this is a snug (but freely-rotating) fit – the number required will depend upon how far into the handle boss the rod has been screwed. In our case, three standard washers were sufficient (Photo 70).

69



"It is necessary to remove any weld which is not flush with, or recessed into, the column and base-ring, to ensure that the base will sit flush to the baseplate of the tender..."

PHOTO 68: Assembly of handbrake column base completed and unit ready for welding.

PHOTO 69: Installing the thrust-bearing onto the bottom of the handbrake column.

PHOTO 70: E-clip and washers installed.

PHOTO 71: Assembled handbrake control unit.

Photos and diagrams by the authors

70



71



72



“The complete, assembled, handbrake column should rotate smoothly and freely on its thrust-bearing and is a delight to operate...”

73

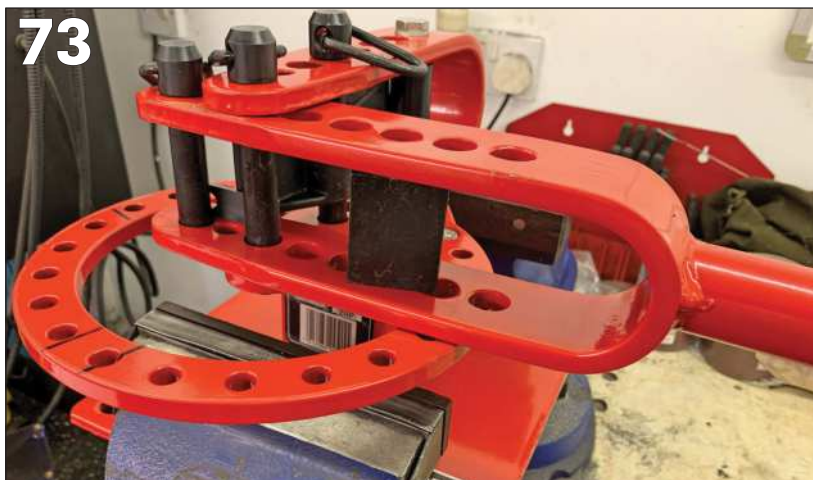


PHOTO 72:

Marking the bend position for the attachment brackets, made from 3mm mild steel.

PHOTO 73:

Bending of a bracket underway.

74



PHOTO 74:

Bend setup, showing the bend-line marked on the bracket.

PHOTO 75:

A completed set of brackets.

PHOTO 76:

Captive nuts TIG-welded in place on each bracket.

75



76



The complete, assembled, handbrake column should rotate smoothly and freely on its thrust-bearing and is a delight to operate – our completed example is shown in **Photo 71**.

Upper-body attachment brackets

The upper body is attached to the baseplate using five brackets. The aim of this simple attachment system was to make it easy to remove the tender body from its chassis, to allow access to the water tank, for example, should it need cleaning.

The brackets are very simple (**Figure 47**) and were fabricated from the same 3mm mild steel which was used for the tender body itself. Since the brackets were laser-cut, they needed to be bent prior to fitting (welding) to the body. To do this, a bend-line was added as shown in **Photo 72**.

Photo 73 and **Photo 74** show the bender used and the bending process, including the setup of the bend-line in the bender (**Photo 74**). This is the same bender we used to form the brake control handle, discussed earlier in this series.

Photo 75 shows a completed set of brackets and **Photo 76** shows three of the brackets with ‘captive’ nuts (stainless steel) welded in place. These brackets will be fitted (welded) to the tender body, with the captive nuts allowing the body to then be bolted to the baseplate. **EIM**

■ Next month Peter and Matthew turn to making the water taps for their fully functioning tender.

Parts 1 to 4 of this series appeared in the November 2022 to February 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.

An insight into miniature injectors

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

BY ROY C PRESTON Part Two of three

Last month I began my project to answer two key questions regarding the performance of miniature injectors, these being “How important are the different dimensions?” and “How does any variation from the published dimensions influence performance?”

As detailed in the first part of this short series I have built a group of six 26 oz/min miniature injectors and an experimental test facility, the plan being to vary dimensions of the injector cones and measure performance, comparing the results. The full project has been published in detail as a digital download, available at this link (<https://bit.ly/3hZDjhz>).

A theoretical model

During the measurements undertaken for this project, it seemed that well-made injectors to the standard design of Brown (2011 – *full references included in part one of this series*) or Lawrence (1986) showed behaviour that may be predictable. In particular, it was apparent that the dimensions of the combining cones seemed not to play a critical part in the operation of the injectors. This is even though what is going on inside an injector looks like a complex system of multi-phase transitions involving steam condensing in water to produce a high-pressure water jet.

Steps used in the theoretical model

To set up a theoretical model, the various processes going on in an injector were treated as a few simple theoretical steps. These are:

- 1) Steam passing through the steam cone throat at the speed of sound
- 2) Steam expanding as a calculable Laval nozzle to exit at supersonic speed from the steam cone and at low pressure
- 3) Suction of the water at the annular area between the outside of the steam cone and the bore of the draught tube, with water-flow rate determined using the Bernoulli energy equation
- 4) Conservation of momentum of the steam at the outlet of the steam cone to the momentum of the water at the

- inlet of the delivery cone
- 5) Conservation of total energy between the output of the steam cone and the entrance to the delivery cone
- 6) Conversion of high-velocity water to high-pressure water in the expanding delivery cone based on the Bernoulli energy equation and conservation of mass flow rate

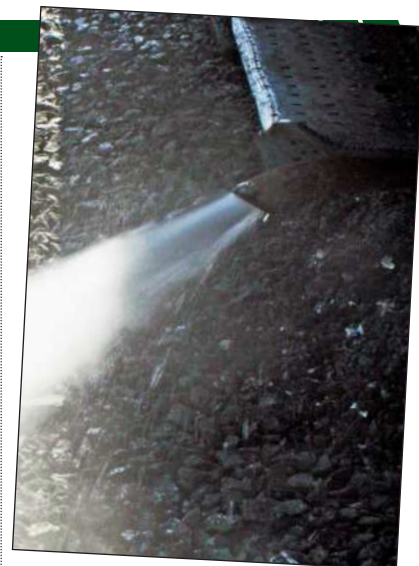
The model

For full details of the theory, equations, and calculations, see Preston (2021). Here, only the main steps are outlined. The calculations were performed using Microsoft Excel spreadsheets for ease and they provided a ready means of creating graphical output for comparison with experimental results, also gathered using Excel.

Steam cone throat calculation

The speed of sound at the throat is calculable from standard equations given the steam pressure, density, and ratio of specific heats, and also available from dry steam tables given just the pressure. It should be noted that the shape of the steam cone before the throat has no influence on the speed of sound at the throat. Although it is shown in Figure 13 as a converging cone, this is not critical

“What is going on inside an injector looks like a complex system of multi-phase transitions involving steam condensing in water...”



but does provide a smooth steam flow prior to the throat, a feature that may be preferable.

The steam mass flow through the throat can then be calculated by standard equations in terms of the area of the throat, supply steam pressure and density, and ratio of specific heats.

Expansion of the steam through a Laval nozzle

After the steam exits the throat at the speed of sound it will expand and accelerate along the diverging cone, a

FIGURE 13:

The different injector dimensions that were used in the theoretical model for this project.

All diagrams by the author

FIGURE 13

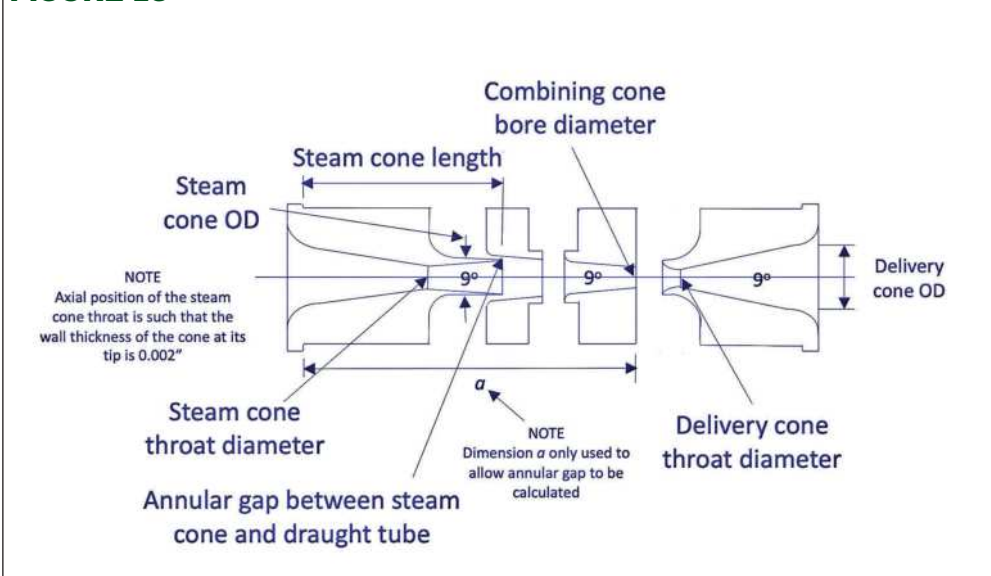
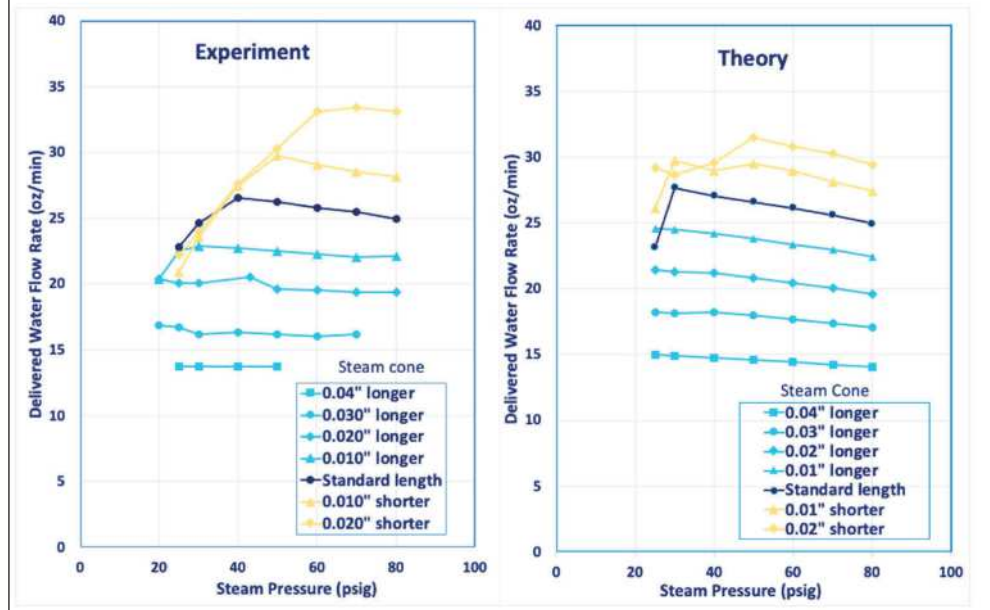


FIGURE 14



process calculable using published Laval theory. The Mach number for the Laval steam cone depends only on the ratio of the specific heats and the ratio of the area of the throat to the area of the nozzle at the exit, in other words the tip of the steam cone. Once the Mach number is known, the velocity of steam at the output of the steam cone can be calculated.

An alternative method of determining the exit velocity of steam is to use yet another Laval equation. This gave lower values for the exit velocity than simply using the Mach number. Also, an alternative method of doing these calculations was to use steam tables and conservation of Entropy and mass flow, Preston (2021). The steam tables method gave results for the steam-cone exit velocity

similar to those based on a Laval equation, but lower than those given by simply using the Mach number by about 20 per cent.

It was decided to use the basic Laval equation for the exit steam velocity after reducing it by 10 per cent based on published data on losses in Laval nozzles.

The absolute pressure at the output of the steam cone was also calculated based on another Laval equation. The absolute output pressure is proportional to the steam pressure at the inlet to the cone and depends on the Mach number.

For a typical steam cone, the output pressure is always less than atmospheric pressure. This means that as the steam pressure increases the output pressure also increases, in

“The water is now entering the draught tube as a tubular column inside which is a supersonic steam jet moving laser-like on the axis of the injector...”

other words there is less vacuum. The absolute pressure, the vacuum level, at the output of the steam cone was then calculated as a function of steam pressure.

Water flow calculation

The vacuum at the output of the steam cone is the driver to draw water through the annular gap. This overall water flow-rate is calculated using the Bernoulli energy equation which requires the area of the gap to be known and the pressure drop from the water delivery to the end of the steam cone, in other words the difference between atmospheric pressure and the exit steam pressure at the steam-cone tip, as determined above.

At high water flow-rates and low steam pressures, experimental results often showed a measurable suction at the water inlet (up to a few inches of mercury). As this would reduce the pressure drop across the annular gap, the measured vacuum at the water inlet was also used to correct the theoretical calculations of water flow as they assumed atmospheric pressure at the water inlet.

Transfer of momentum from steam to water

The water is now entering the draught tube as a tubular column inside which is a supersonic steam jet moving laser-like on the axis of the injector. The water enters the draught tube with virtually no kinetic energy, but the steam has by comparison large kinetic energy because of its high velocity. This energy is gradually transferred radially to the water giving up kinetic energy and latent heat of evaporation.

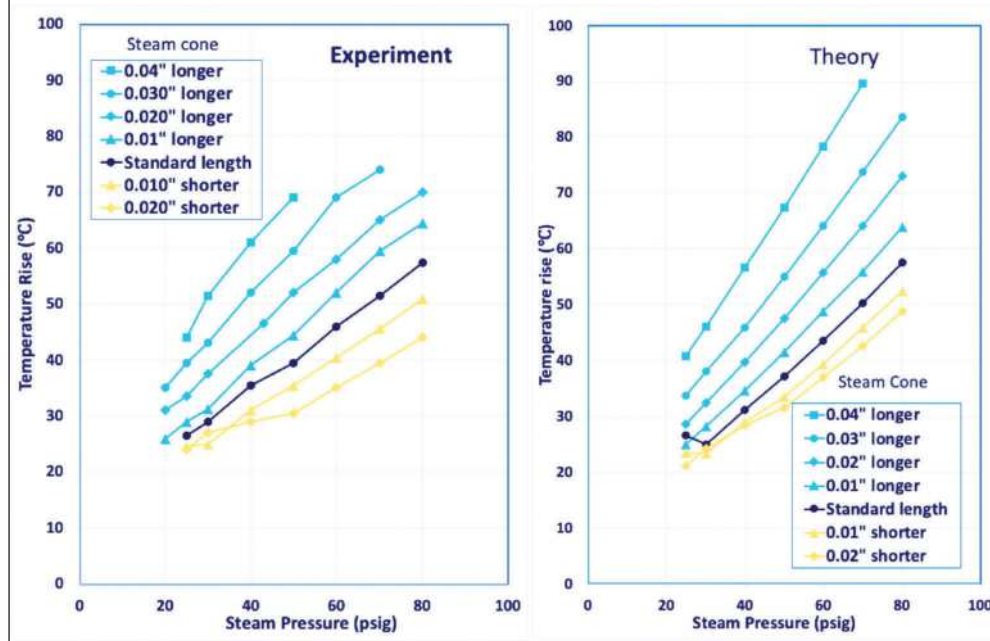
It is now assumed that by the time the column of water/steam reaches the delivery cone, all the steam has condensed leaving a small diameter water column of high velocity. Whilst all the kinetic energy was in the steam at the exit of the steam cone, it is now wholly in the water.

As we know the velocity and mass flow rate of steam at the exit of the steam cone and the mass of water entering the draught tube, a simple calculation using the conservation of momentum can be applied to calculate the velocity of water at the entrance to the delivery cone.

To calculate the temperature of the water when it reaches the delivery cone, the conservation of energy equation is used. This involves calculating the steam energy at the output of the steam cone and equating it to the water energy at the entrance to the delivery cone.

The steam at the steam cone has kinetic energy and latent heat of condensation and the water at the

FIGURE 15



delivery cone has the kinetic energy of the water and its thermal energy from its temperature rise, the only unknown in the equation.

The diameter of the water column at the entrance to the delivery cone can also be calculated knowing the mass flow rate and velocity of the water. It will be seen later that comparing the calculated water column diameter with the forcing-tube exit diameter, or the delivery-cone throat diameter, is a useful guide to performance especially at low steam pressures where the column diameter is largest.

(NOTE – If referring to Preston (2021) there is a typographical error in equation 12. In the brackets, the positive sign should be negative. However, the calculated values given and the plots such as Figure 34 use the correct equation, so the values are correct.)

Transfer through the delivery cone

After the column of water passes through the throat of the delivery cone it will expand along the taper of the cone, a process that can be calculated in terms of the Bernoulli energy equation. To calculate the outlet pressure, the parameters required are the pressure at the entrance, which is assumed to be atmospheric, the previously calculated velocity of the water column, the velocity at the outlet which can be calculated by conservation of mass flow, and the diameters of the throat and exit of the delivery cone.

Experiment and theory compared

Delivered water flow rates

Figure 14 shows the comparison of experimental measurements of delivered water flow-rate for different steam cone lengths, as shown previously in Figure 10, with the theoretical predictions. Overall, there is a surprisingly good agreement.

At the low pressures and higher flow-rates, the variations seen in the theoretical results come from the corrections for the vacuum levels at the water entrance, these vacuum measurements not being very reliable. The differences at low flow-rates and higher steam pressures are a result of the theory not yet taking account of overheating of the water.

Temperature rises

For temperature rise, the experimental and theoretical results shown in Figure 15 are also in surprisingly good agreement, again except mainly for the theory not limiting the maximum temperature rise for the water.

Delivered water pressure

Figure 16 shows the prediction of the

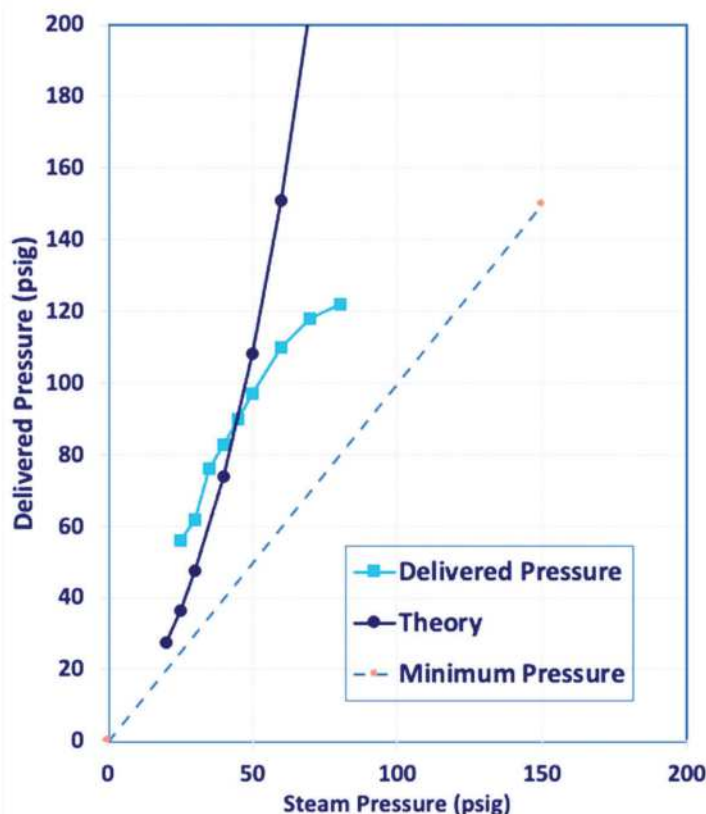
“All injectors tested were able to deliver pressures up to twice the steam pressure over much of their mid-operating pressure range...”

FIGURE 14: Comparison of experimental and theoretical delivery water flow rates for different steam cone lengths (0.04-inch longer to 0.02-inch shorter than the standard).

FIGURE 15: Comparison of experimental and theoretical delivery water temperature rates for different steam cone lengths (0.04-inch longer to 0.02-inch shorter than the standard).

FIGURE 16: Comparison of experimental and theoretical delivered water pressure compared with the minimum pressure needed to fill a boiler.

FIGURE 16



water delivery pressure compared with the measured maximum pressure using the test facility and adding additional output load until the injector stopped working. The overall shape of the experimental pressure curve was the same for a number of injectors tested.

In addition, there was a drop in the water delivery rates of up to about 60 per cent of the maximum value with no additional load. The straight line is the boiler pressure.

The theory predicts a delivery pressure below the experimental values at low steam pressures but much higher as the steam pressure increases. At a steam pressure of 50 psig, both the theoretical and experimental values are similar and double the boiler pressure.

It is not clear why the measured delivered pressure flattens off above 50 psig. It is unlikely to be associated with the modification to the dummy load using an additional load applied by a compression spring, simply because above 50 psig the difference between the measured load and the boiler pressure decreases, which seems to indicate that the dummy load worked. It is possible there are other factors influencing the delivered pressure.

One possible explanation could be that air is being absorbed into the water column which makes the assumption of incompressible fluid flow through the delivery cone incorrect. As already mentioned, in

most experimental measurements, as the steam pressure increases, the overflow changes from slow water flow to slight suction.

The suction has been attributed to the water column decreasing in diameter, thereby allowing a small gap between the forcing-tube bore and the water column to pull air from the overflow. Whilst this will reduce the partial vacuum, the air has then to be absorbed into the water column making it slightly compressible. Whilst this may be the explanation, the water temperature will be high making absorption of air less likely.

The alternative explanation could be the water flow into the delivery-cone throat draws air directly into the water column by the Venturi effect, with the same result. Dissolved air in the water, by whichever process, may well be the reason for the limitation to the delivered maximum pressure.

Nevertheless, the main conclusion is that all injectors tested were able to deliver pressures up to twice the steam pressure over much of their mid-operating pressure range and always a higher delivered pressure than the boiler pressure. **EIM**

■ Next month Roy concludes his injector experiments by fully analysing the results he has obtained.

Part one of this short series was published in **EIM** last month. Details of how to obtain a digital or printed back number are on page 10.

Conway – a first steam locomotive build

Richard concludes his short series designed to take some of the mystery out of loco building for novices with that milestone moment of a first steaming.

BY RICH WIGHTMAN Part Four of four

46



Having achieved the major milestone of completing the boiler, as described last month, building the rest of the locomotive is machine work and can be tackled in any order that suits you – and the more machining you do the better you will become at it. I found that even if parts are made exactly to plan a certain amount of fettling will be required to get things to fit, moving and rotating freely.

Incidentally I bought laser-cut coupling and connecting rods for 'Conway' thinking this would save time and money. A problem I had, however, was that my parts were bowed which can be common with laser-cut parts due to the heat involved. With patience and some gentle persuasion in the press I got them straightened out and then machined them. On my second loco build, 'Chub' I have made the rods from steel bar.

A rush of air

The next milestone to reach is getting the chassis to run on air. If the loco is suspended on its work frame you need to chock the axle boxes with something of a suitable thickness to keep the axles approximately at their normal running height or at least halfway up the axlebox, rather than letting the axles drop to the bottom of the horns.

A connection for an air line will need to be made up, preferably with a little regulator tap, and attached to the steam T-piece. You then move the forward reverse lever into forward gear, lubricate every moving part well and then open the air valve – all being well the chassis will come to life and turn. There is no greater feeling than to see your first loco run.

If it doesn't turn at first asking, be very wary of giving the wheels a turn by hand. These are powerful little engines and will happily remove a knuckle or two from the unsuspecting builder if they kick over. Go on, ask me how I know! Turn the air supply off before turning the chassis by hand. Dribbling some oil down the air connection will help.



If the loco does run make sure that you try it in reverse as well. It should be pretty even in its turning over in both directions. Getting the valve timing right for nice even motion in both directions can be a fiddly and time-consuming job but it is a lot easier if it's done now before the boiler and bodywork is fitted.

Once you are happy with the way your model runs you can finish the build. A short video of Conway running on air can be seen here <https://bit.ly/3kKv5uK> – she is sitting on my home-made rolling road.

Once the loco build is complete it will be time to carry out another hydraulic test at one and a half times working pressure. Conway's working pressure is 80psi so this second test is done at 120psi with all the boiler fittings in place. One thing that can be removed and suitably bunged is the pressure gauge which could be damaged. I did all these initial tests at home before taking her to the club and Conway's pressure gauge is OK up to 150psi so was left attached.

If all is well it's now time to light a fire which of course is best done outside. The rolling road I built fits onto my scissor lift so is ideal for running the loco at its correct height. All that is needed are a couple of zip ties through the towing couplings just to make sure she can't jump off.

First step is to fill the boiler and the tanks with water to the correct height. Check the hand pump works okay and fill the lubricator.

Firing a loco is a trial-and-error job. A coal shovel and a rake will be required, (Photo 46), I showed how I made mine in a while back in this magazine (EIM April 2020 – Ed).

47



No two locos will behave in exactly the same way. I have found that a thin layer of coal first followed by some wood soaked in paint-brush cleaner gets things going.

You will need the blower in the chimney to help create a draft. I made my blower (**Photo 47**) from a fan salvaged from a central-heating boiler and a small 12-volt motor. Our club has a 12-volt supply in the steaming bays but the blower will happily run off a battery from a cordless drill.

As the fire takes hold slowly feed in the coal. When the boiler pressure reaches 30psi turn on the steam blower and remove the electric one from the chimney. The pressure should increase steadily to the working pressure of 80psi at which point the safety valve if set correctly should blow off.

Now you have to keep an eye on the water level, the fire and the pressure gauge – plenty of tasks to keep you busy. Initially water will drip from the cylinder drain cocks until the cylinders warm up. Pushing the loco forward and backward a little will help to remove any condensed steam from the cylinders.

Moment of truth

Once on the track move the gear into forward and then open the regulator. The loco should run. YeeeeeeeeeeeeeeHaaaaaaahhhhhhhhh. I had one or two teething problems to sort out but nothing major.

One thing I will mention is the ash pan. After a successful day's running the boiler is blown down and the ash pan dropped by pulling out a long pin. The ash pan on Conway made as per the plans is four inches wide so would not drop through the 3½-inch gauge track in the steaming bay, instead



becoming lodged underneath the loco. With some assistance I had to lift the loco up at the back and pull the ash pan clear with the poker. As a result I made up a modified ash pan to make things easier.

Before leaving the track the loco benefits from a good wipe down with a rag to clean her up. Back home the smokebox door is opened and a flue brush poked down all the tubes. I have an old vacuum cleaner in the garage which sucks out all the debris from the smokebox.

Earlier in this series I mentioned a few other things that you will need. Remember I said collect as much as you can in scrap and off-cuts, now is the time you need it.

Firstly you want a short length of track – three or four feet will do, just enough to roll the loco back and forth. This can be something as simple as a length of MDF with 10mm square bar

PHOTO 46: Home-made shovels make firing easy.

PHOTO 47: Steam-raising blower made from a central-heating fan.

PHOTO 48: Rich's loco lift on his short section of track.

PHOTO 49: High-mounted hoist takes effort out of lifting.

PHOTO 50: Rolling road – a simple build.

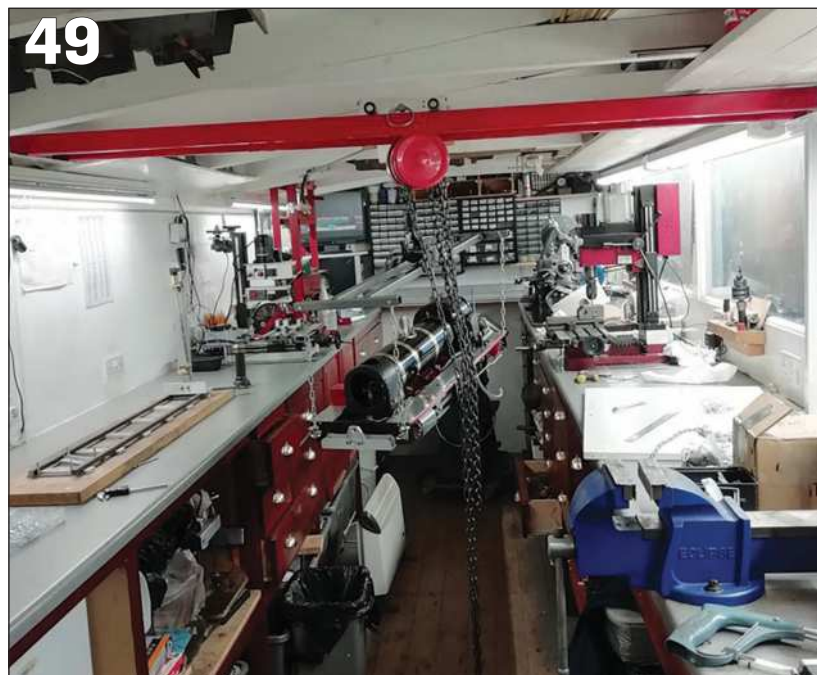
screwed to it. Or if you have a router two slots routed along its length at the appropriate gauge will do.

These locos are heavy and you will need to turn your model over to work underneath it. I made myself a lift from two handles and threaded rods salvaged from a scrap cheapo Black & Decker Workmate. It clamps onto the end of the rails (**Photo 48**).

Taking the weight

A hoist in the workshop is very useful as if the loco you build is anything like the size of Conway it will be too heavy to lift off the bench. My hoist is mounted on roller bearings on a rail above so that I can roll it from bench to bench. I have made a cradle with chains that clip onto eyes mounted in the front and rear buffer beams (**Photo 49**).

Another very useful item is a rolling road, the best means of testing ►



51



52



"Most of what I have listed has cost me very little, just a bit of time and effort and materials gathered for free..."

the loco on air and eventually on steam. You could just suspend the loco on wooden blocks underneath the buffer beams but it's best to have it on its wheels so that it sits at its true riding height. You can easily make your own rolling road – ball bearings are quite cheap and simply need mounting on some angle or whatever

(Photo 50). Mine clamp onto my scissor lift and I have made them wide enough to take an extra set of bearings to accommodate a 5-inch gauge loco.

My scissor lift was made from angle iron and steel tube. A scissor jack from a scrap car provides the force to lift and lower it. Mounted on braked castors it wheels easily from the workshop to the car (Photo 51).

You will need a good tool box to take with you in which you can accommodate all the necessary bits and pieces – funnels, oil cans, spanners and such like – it soon mounts up.

Most of what I have listed has cost me very little, just a bit of time and effort and materials gathered for free.

Well there you are, a steam loco that has provided me with many hours of entertainment (Photo 52-54). I hope I have given you the inspiration and confidence to have a go at building a steam loco and in some small way helped with some of the things you'll need to do to complete the task. **EIM**

■ Editor's note: As Rich indicated at the start of his short series, this was never intended to be a blow-by-blow account of building a steam locomotive but an eye-opener for novices keen but perhaps also hesitant to tackle their first build, highlighting some of the pitfalls to avoid but hopefully mainly emphasising that there is nothing to dissuade you from embarking on such a project.

We hope more readers will take on their first loco builds, and of course document them for our pages. But meanwhile if there is any aspect of loco building, or indeed model engineering in general, that you are unsure about and would like more of an insight into, drop a line to editor@engineeringinminiature.co.uk and we'll get our more experienced contributors on the case.

Parts 1 to 3 of this series appeared in the December 2022 to February 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.

PHOTO 51:

A scissor-lift on wheels, with correctly-gauged rail bolted to the top, makes moving the loco about a very simple task.

PHOTO 52-54:

The very few complications involved in this first loco build were far outweighed by the sheer pleasure it gives to Rich when running on the track.

Photos by the author

53



54



Building a large-scale Fowler Steam Lorry

Martin brings us the latest update on his 7-inch scale road engine build project, which in recent months has reached the milestone point of a first steaming.

BY MARTIN JOHNSON Part Eight of an occasional series

At the end of my last article I promised some detail on the superheater for my 7-inch scale Fowler steam lorry. The first thing to say is that a good superheater is vital on an underframe steam lorry and in my view that was why the Sentinel lorry was such a successful product.

This model therefore takes inspiration from the later Sentinel superheater design in having twin coils, each consisting of a downward and upward concentric spiral, mounted in the smokebox. My calculations showed that each coil needed around three turns to give a target steam temperature of 350 degrees C.

Superheaters

The superheaters are $\frac{3}{8}$ -inch BSP pipe which has an outside diameter of about 17mm – I used heavy gauge so winding coils of this material is quite a task and needs some jigs to ensure the coils are in the right place. The jigs were based on two laser-cut discs shown in **Photo 101** comprising a lot of holes.

There are four rings of holes which will take M12 screwed rod to form coils of four different diameters and there are larger holes to take the entry and exit pipes. The offset notch marks the front of the vehicle and allows the plates to be readily aligned right-way up. CAD certainly offers advantages as much of the detail for these jig plates could be picked off other drawings, ensuring that everything would line up when finished.

The next step was to build up a 'cotton reel' using the two plates and a ring of M12 screwed rods assembled into the smallest ring of holes. Next, I threaded and capped off one end of two 5-metre lengths of pipe and filled them with dry paving sand; this involved propping the pipes vertically against the house and standing at the top of a ladder pouring the sand into the open top. Once full the top end of the pipe was capped off.

Next, I used the built-up jig to put a 90-degree bend on the end of each pipe, which were heated to red heat for bending using the cutting head of my oxy-propane torch. **Photo 102** shows a

pipe bent to 90 degrees at the bottom – note the length of $\frac{3}{8}$ -inch BSP thread, two backnuts and a cap. The upper part shows a similar pipe assembled into the jig using the backnuts to position the pipe axially.

The jig also includes a number of hooked pipe hangers that will support the coils in the smokebox, but are used here to determine the axial position and pitch of the coils. The coils have to clear the smokebox tubeplate (obviously!) and pass under the bracket supporting the blast nozzle, so there is not very much room for error.

Photo 103 shows the same setup from the operator's position. The whole jig pivots on an axle, so as each section of pipe is heated to red, a lever is used to roll up the pipe into a coil; by keeping a steady pressure on the lever to turn the jig one can feel when the pipe softens.

It will be seen that there is quite a length to wind needing the whole of the garage. The innermost coils are nearly complete in this view and M12 rods are being assembled to form the cotton reel for the outer coil. One of the hooked coil supports can be seen at the bottom of the picture.

In **Photo 104** the outer coil has been completed and the pipe has been bent 90 degrees to leave the jig axially. ►

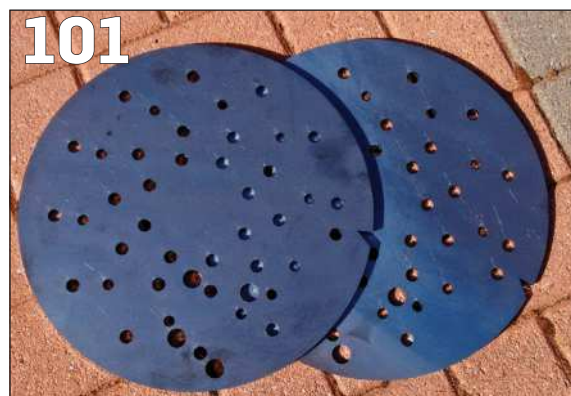
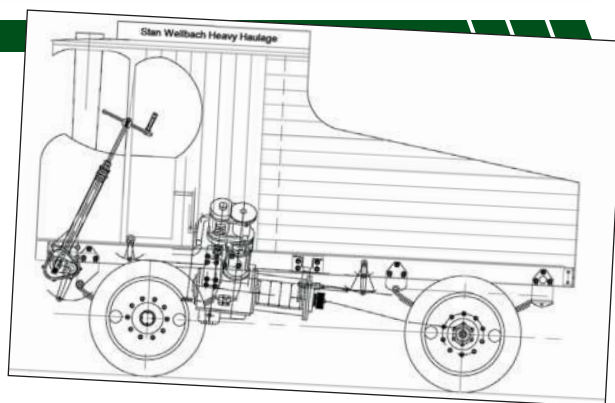


PHOTO 101: Basis of superheater winding jig, a pair of laser-cut plates.

PHOTO 102: Superheater winding in progress.

PHOTO 103: Coil winding from the operator's position. Note support axle for the jig and length of pipe to be coiled.



105



104

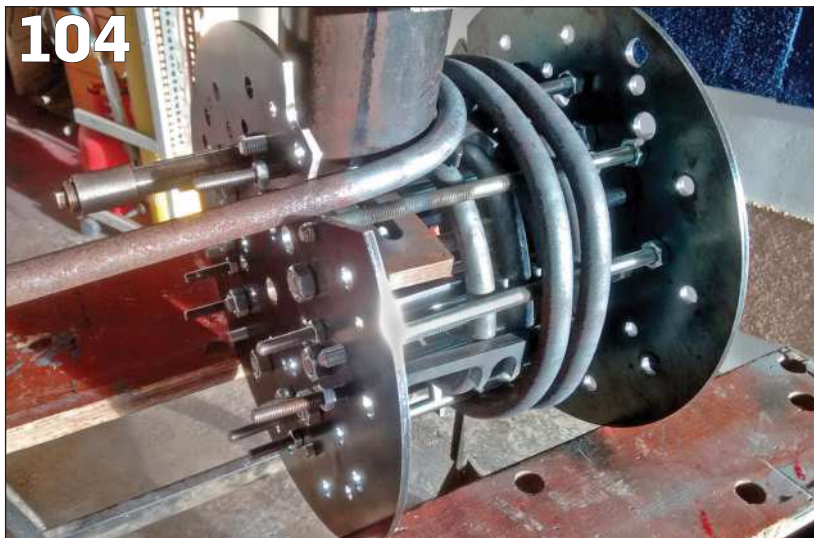


PHOTO 104: Outer coil complete, pipe bent to exit location using a piece of 4-inch tube clamped to the jig.

PHOTO 105: Guided die stock made for threading tails on superheaters.

PHOTO 106: View 'upwards' into the smokebox and superheater.

PHOTO 107: View of smokebox, chimney opening at top with blower nozzle and four-orifice nozzle visible

106



The V-shaped location in the jig matches the pipe exit location on the smokebox lid.

Next the complete jig has to be dismantled to extract the concentric coils. After that, the whole process is repeated to produce a similar component, but which will be fitted between the inside and outside coils of the first part.

The next job on the superheaters was to empty the coil of sand by plenty of jiggling, banging and blowing and then to trim to second end to length – my best tip is to be patient with the jiggling as using compressed air too soon can compress the sand and make the job a lot harder.

Next, the tail had to be threaded, but the first tail gets in the way of a conventional die stock. **Photo 105** shows my solution of a special guided die holder with a removable arm, so the die could be rotated windlass-style and the arm could be removed from each socket to miss the first leg.

Finally, the two superheaters along with the exhaust pipes, blast nozzle and blower were assembled to the smokebox 'door' so that the whole thing can be removed as an assembly for maintenance.

Photo 106 shows the view that the smoke sees passing up into the smokebox and superheater. The coils are quite tightly packed, so there should be good heat exchange. The coils are all supported by at least two 'hook' supports. Note also the stove seal rope to seal the joint between smokebox and boiler top. The stove chute will pass down the circular hole in the middle.

107



Chimney and blastpipe

I am trying some of my own ideas for the draughting. The system is basically a Lempor exhaust but without Kordinas because there are not four individual exhaust lines. The exhausts join at the feedwater heater, then two pipes run to the blastpipe which is a steel block capped by a steel plate. The blast nozzles are simply four countersunk orifices in this plate.

This might seem a poor design compared to carefully tapered nozzles but I realised that due to the 'vena contracta' effect (*the point in a fluid stream where the diameter of the stream is the least, and fluid velocity is at its maximum – Ed*), the performance of a carefully tapered nozzle and an orifice will be virtually identical **provided** the orifice is made slightly larger to compensate for the vena contracta. The advantage is that orifice nozzles are shorter, so allow a slightly longer chimney which in turn gives improved performance; they are also very easy to manufacture.

I have chosen to keep the orifices somewhat below the chimney throat to ensure good entrainment of flue gas. The blower nozzle is in the centre of the four main orifices and also features four nozzles pointing outwards from the chimney centreline, to ensure the flow pattern 'fills' the chimney.

Photo 107 shows a view into the chimney opening, and the square blower nozzle (bronze) can be seen in the centre surrounded by four blast nozzles. The exhaust pipe connections are at the bottom of the figure.

Photo 108 shows a side view of the



PHOTO 108: Side view of superheater and blast nozzle assembly.

PHOTO 109: Chimney during assembly. Note tapered wooden plugs behind.

PHOTO 110: Two grate half castings, with the grate from 4-inch Burrell for comparison.

PHOTO 111: Ashpan and grate hinged down. Note catch for grate just under clinker hole door.

Photos and diagrams by the author unless stated.

superheater and blastpipe block (the bright steel octagonal item top right) just below the chimney bellmouth entry with one exhaust pipe feeding in from the left. Below are the superheater coils, note the tight clearance between the superheater pipes and exhaust pipes. The copper pipe is the blower steam supply.

The chimney comprises four pieces – a bellmouth entry and flange which is welded to the smokebox lid, mating flange and parallel section and an outward tapering diffuser of six degrees internal angle. The assembly is welded together and capped off with a decorative brass top and a heat shield.

The most difficult part was rolling the tapered section. In theory this cannot be done on parallel rolls but in practice can be achieved by rolling in short sections and skidding the work round to keep the plane of the bend aligned to the chimney axis.

Final assembly was achieved using two wooden plugs on a length of screwed rod as a former and pulling the rolled steel to shape using Jubilee clips as shown in **Photo 109**. A riveted butt strap was used for the joint and the tapered section was MIG-welded

to the lower parallel section. The job also required a considerable helping of brute force...

Grate and ashpan

No boiler is complete without a fire, so something to hold it was needed. The model follows Sentinel practice quite closely in that the grate is in two halves, supported on a steel frame hinged at the back of the boiler and held up with a catch at the front of the boiler. The ashpan is hinged on the same pin that supports the grate and is held up by a control linkage operated from the cab.

First job was a pattern for the grate half, which is one of most fiddly I have made! **Photo 110** shows the resulting two castings, along with the grate from my 4-inch scale Burrell for a size comparison – this is quite a beast.

The ashpan started life as an 18-inch catering saucepan – the handles were removed and the pan shortened by running it through my circular saw bench. Make sure you use a fine-toothed blade for such a job, preferably a new carbide one.

Next, brackets were made to hinge on a pin held in trunnions at the rear



of the boiler. **Photo 111** shows the ashpan and grate dropped as they would be if required for dropping the fire in a hurry or cleaning out before lighting up.

Photo 112 is a view up below the boiler showing the frame which supports the grate. Each grate half has locating pegs which fit into holes in the support frame and can be seen toward the bottom left. In this picture the ashpan is lowered as it would be for raking out the ashes.

Keeping the heat in

The driver and fireman are forced to sit close to the boiler in a fairly confined cab, so lagging is very important for crew comfort. Hence I





PHOTO 112: View underneath boiler, showing grate supported on hinged frame.

PHOTO 113: Boiler crinolines being formed over block former.

PHOTO 114: Boiler cleading in progress on driver's side. Note foil lagging around smokebox.

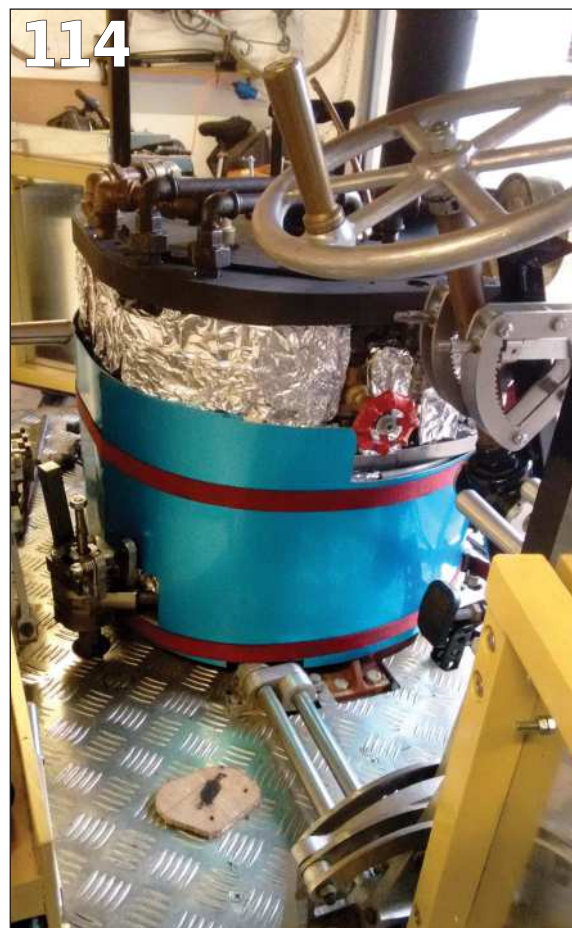
PHOTO 115: Completed lagging and cleading seen from fireman's side.

PHOTO 116: Injector (right) and remote operated water valve (centre) with associated pipework.

PHOTO 117: View into main mechanical lubricator showing input shaft (left) and crank shaft below right.

PHOTO 118: Oil pump installed on gearbox offside.

PHOTO 119: Steam pump showing dosing pump mounted at front. The lubricator is at far right.



chose to use 25mm Kaowool sandwiched in aluminium foil. Lagging the boiler was quite easy with just two sheets, but the smokebox area needed countless small pieces, each of which is sealed round the edges with special aluminium tape.

Most of the steam and exhaust pipes and valves are under the lagging to reduce heat leakage. The firebox section of the boiler under the cab floor is not lagged due to lack of space and the originals weren't lagged in that area either.

The aluminium cleading is supported on aluminium crinolines which started as a laser-cut shape and were then flanged over a hardwood former. I found that aluminium can be annealed in a gas barbecue set on highest temperature, which speeded the job up, was more efficient on gas use than the workshop torch and smelt delicious!

Photo 113 shows a finished crinoline (top), a part-formed one (bottom) and the forming block underneath. The blanks are located by the three bolt holes and parts were made in left and right-hand formats along with other variants with and without the bolting lugs.

Photo 114 shows the lagged boiler on the driver's side, with cleading part fitted and temporarily retained with ratchet straps; note the foil-backed lagging around the smokebox section. **Photo 115** shows the finished lagging and cleading from the fireman's side, with valve spindles and handles outside the lagging. The boiler bands are stainless steel with aluminium angles riveted at the ends.

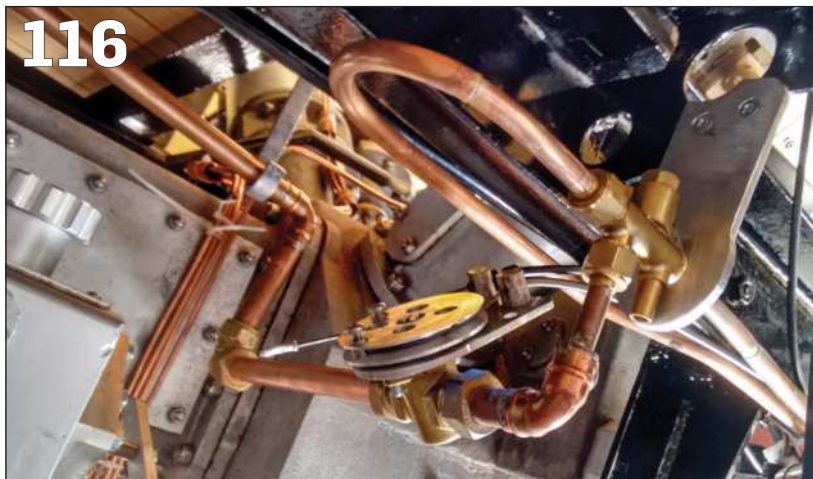
Plumbing

There has been a lot of plumbing to do over this last year which has included main steam lines in screwed iron pipe, exhaust lines mostly in 22mm copper, safety valve exhaust in 28mm copper, auxiliary steam lines in 8 and 10mm copper and the water feed in 15 and 10mm copper.

One problem that did present itself was how to produce neat bends in the 8 and 10mm copper pipe. Commercial benders are widely available on the internet and all seem to come from the same Chinese mould, but the bend radius for 8 and 10mm pipe is far too tight leading to crinkled bends. The solution was to make my own bender with an appropriate bending radius.

One item that was a bit out of the





ordinary was the injector water valve, which could not be arranged for direct operation from the footplate. The solution was to operate the valve by a Bowden cable (bicycle brake cables) from the footplate. **Photo 116** shows the injector and associated valve with the Bowden cable turning an aluminium wheel to actuate the valve. At footplate level a similar setup is operated by the water lever.

Bicycle brake cables have also been quite extensively used for operating cylinder draincocks, the main steam-line drain, ashpan damper, regulator and whistle – they are far easier to thread around other services than rods and levers.

Lubrication & Feed Dosing

The boiler is capable of delivering steam with a good superheat, and that demands good lubrication at the engine. I was not prepared to trust that injection at one point would take the oil where needed in the right quantities, so I designed and made a six-feed lubricator. This delivers to the piston-valve top and bottom bobbins and the cylinder on both sides of the engine so that lubrication at the key points is assured.

The basic pump elements are a 'ruggedised' version of the Jim Ewins O-ring pump. The pump is driven by a 2:1-reduction poly V-belt from the engine and uses one-way clutches to

reduce the shaft speed by a further $\frac{1}{30}$ th, giving a 60:1 overall reduction.

Photo 117 shows a view into the pump tank with the input shaft on the left, and at centre an eccentric operating an alloy oscillating fork, which drives the pump shaft through a one-way clutch.

The usual scotch-crank drives can be seen on the pump crankshaft. Both shafts are supported on ball or roller bearings immersed in oil. The oil tank holds sufficient for several days of intensive running, so I hope to fill with oil before attending a rally and avoid the daily oiling-up routine, thus gaining a further half-hour in bed.

Photo 118 shows the oil pump installed with the six feeds clearly evident. Also note the oil-level sight glass and a priming handle on the non-drive end of the pump shaft. All the feeds have a non-return valve adjacent to the delivery point and are run in 4mm pipe. With so many joints to make, I made a pipe flaring tool to avoid making and soldering olives and this style of joint is used for all the 4mm pipe on the engine.

In addition to the six-feed lubricator, I made two single-feed lubricators using the same basic part designs to lubricate the steam pump and future generator.

I also decided that the lorry would have automatic dosing for boiler treatment. This is achieved with



"One problem was how to produce neat bends in the 8 and 10mm copper pipe..."

another Ewins-style pump which feeds a dose of treatment into the steam pump suction line at every stroke of the steam pump.

The treatment pump is simply operated by an extension of the valve rocker on the steam pump as shown in **Photo 119**. The dosing-pump stroke can be adjusted using two locknuts to limit the stroke and hence treatment supplied to the water.

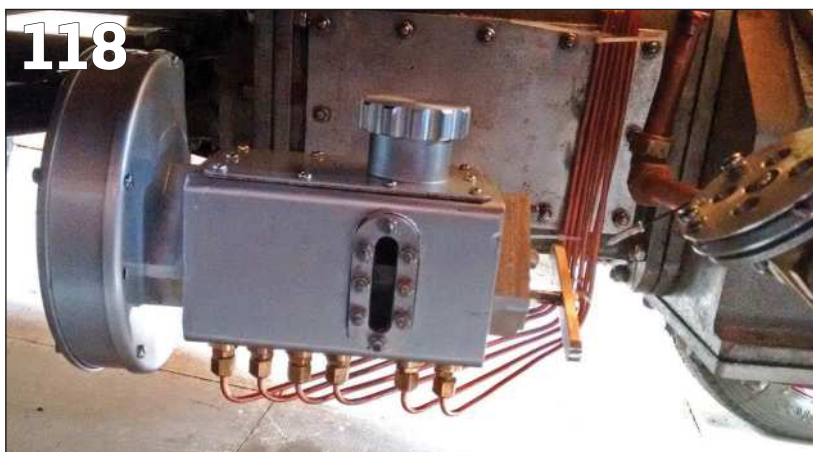
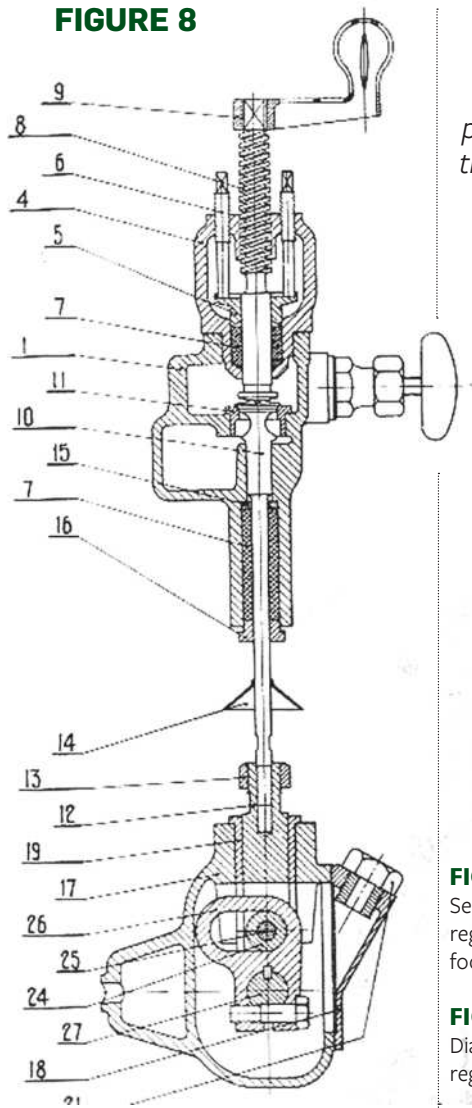


FIGURE 8



The lubricator on the steam pump is also driven by the movement of the valve rocker as in full-size Weir pumps. The steam pump is designed as an assembly which can be removed from the lorry by uncoupling six union connections and undoing four bolts allowing easy bench servicing.

Regulator

The regulator presented quite a design puzzle and I looked around at full-size practice to develop design ideas. The

"The most serious problem was that the lorry was quite reluctant to stop..."

FIGURE 8:

Sentinel S series regulator with foot control.

FIGURE 9:

Diagram showing regulator operation.

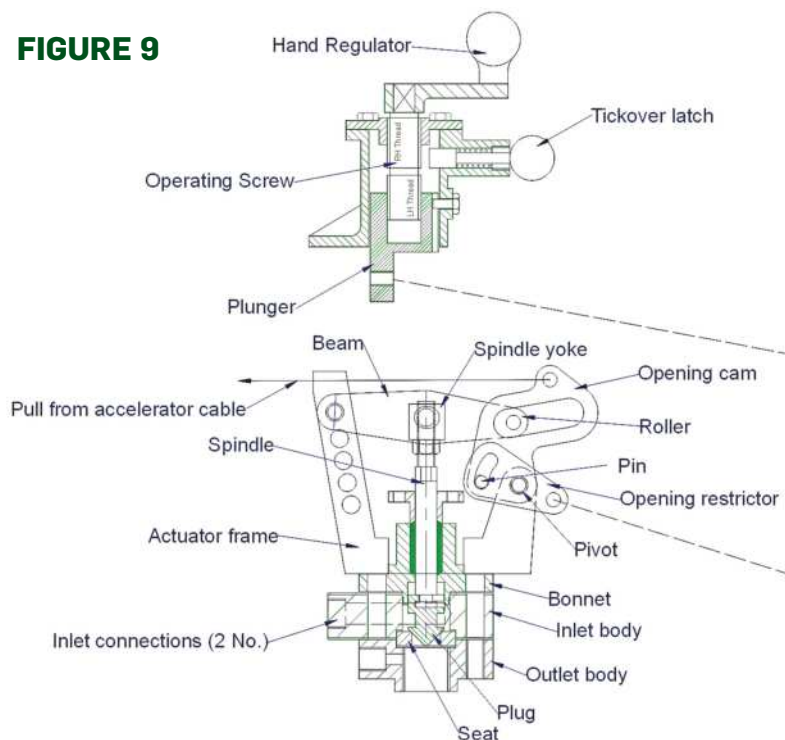
PHOTO 120:

Parts for regulator hand control. Note removable his & hers control handles.

PHOTO 121:

Parts for regulator actuator, not including parts of body and seat, which stay with the pipework installed on the lorry.

FIGURE 9



Fowler regulator was a disc sliding on a face with an auxiliary foot control for manoeuvring. I felt that with the extra superheat this engine has, sliding faces would wear rather quickly. The Garrett wagon had a foot-operated piston valve but correspondence with the owner of one revealed the Garrett setup was not recommended for steam tightness.

Early Sentinel regulators were basically a screw-operated valve, again with a foot-operated auxiliary regulator. The problem with these is shutting the valve in an emergency when one hand is needed for shutting off, one hand is needed for steering, a foot is needed for braking and brain power might be rather strained.

I wanted to develop controls similar to an automatic car – an accelerator pedal and a brake pedal. Above all, it had to give smooth progressive control to be safe on crowded rally fields and stop when the pedal was released.

The inspiration was found in the Sentinel regulator for S-series lorries that enabled both foot and hand control, for which a cross section is shown in Figure 8. The Sentinel valve is actually more complex, but Figure 120 shows enough detail to understand the principle.

The Sentinel regulator is a conical-seat valve which is well able to cope with highly superheated steam. The conical plug (Item 10) can be lifted by a cam (Item 26) which rotates on shaft 27 controlled by the foot pedal. The cam gives a very slow lift initially, but an increasing rate of lift as the pedal is depressed, making the control progressive. However, returning the cam to its shut position ultimately depends on a spring, which are known to break occasionally. In that case, the screwed spindle (8) can be used to force the valve shut. It is also possible to limit the valve opening by the amount the screw (8) is opened, which gives a good way of



ensuring that novice drivers don't get over confident!

My design incorporates the slow-start cam, and the screw to limit valve opening or shut the valve in the event of some failure in the foot-control linkage. However, there are a couple of other requirements for the Fowler model:

- 1) The regulator must be capable of being left open at tickover for engine warming (this is done in other ways on the poppet-valved Sentinel engine)
- 2) The whole assembly must occupy a space of about 5 x 6 inches between the engine and boiler, and be capable of being assembled and maintained in that space
- 3) There is not the vertical space to have the cam assembly underneath as in the Sentinel.

So after a lot of design iterations, I came up with the solution shown in **Figure 9**. For normal operation, the hand regulator would be turned, which lifts the plunger and a rod (shown dotted) connected to the opening restrictor. This then allows the opening cam to rotate anti-clockwise, which lifts the beam and hence the valve spindle and plug. The operation of the opening cam is caused by a pull on the accelerator cable from the foot pedal.

When the pedal is released, the opening cam will be forced clockwise by a torsion spring, shutting the regulator. If for any reason it does not shut it can be forced shut by the hand regulator. As with the Sentinel, hand control can be used to limit the maximum regulator opening under foot control.

If prolonged tickover of the engine is required, the tickover latch is pulled out which allows the hand regulator to lift the plunger further than normal, which rotates the opening restrictor sufficiently to force the opening cam to turn without input from the foot pedal. It's quite a complex mechanism to make operation simple!

The kits of parts for the hand control and the regulator actuator are shown in **Photo 120** and **Photo 121** respectively. There are plenty of components, but mostly simple parts.

The installed regulator is seen in **Photo 122** which shows the restricted space available and the assembly problems quite well. There are two unions on top of the boiler to the right of the hand control which connect to two pipes under the boiler lagging taking steam down to the regulator body. The regulated steam line passes down through the cab floor.

Commissioning

With all the plumbing and various systems finally complete, the urge to light a fire became too strong to resist.



PHOTO 122: View of whole regulator assembly on the boiler.

PHOTO 123: The very first fire is lit after 13 years' work. Photo: P J Johnson

PHOTO 124: 20 yards down the drive later. One small journey for Martin, a giant leap for his project. Photo: P J Johnson

Photos and diagrams by the author unless stated.

■ Parts one to seven of this project appeared in the September and October 2018, March to May 2019, July 2020 and February 2022 editions of **EIM** (to obtain printed or digital back numbers see page 10) and we will continue to carry further features as the build moves to its conclusion. You can also follow construction online at: <https://bit.ly/3JjKrjS> The author can also be contacted via the editor.



of the hand control that would forcibly shut the regulator when the closing velocity between the lorry and my workshop became a little too great for comfort! Nevertheless, I was very pleased with the first test.

The regulator problem has required some re-thinking of the design and some modifications. I am not happy with the fierce safety valve release which is a feature of industrial valves, so will be trialling some modifications on those as well.

You will also notice that the cab is missing the front apron, so next time I shall describe some of the snagging and development jobs and manufacture of the cab front.

There are videos of the second steam test at; <https://bit.ly/3ja9dsi> and <https://bit.ly/3Rdlzw4> **EIM**



Coal of the Future

Edward concludes his description of the Rugby ME's experiments with new 'green' replacements for locomotive coal, as the vital search continues for ways to make possible more sustainable miniature steam in future.

BY EDWARD PARROTT Part Three of three

22



Over the past two issues I've described our continuing efforts and successes at the Rugby ME to establish alternative sources of more sustainable locomotive fuels, as the likelihood of future steam coal supplies (Photo 22) becomes ever more uncertain.

So having had another enjoyable testing session, what next? The two lump coals were the next fuels to be tried, and again we opted for running one engine on one, and the other on the second – there seemed little point running both on the same fuel at the same time, they are essentially the same engine. Both of these lump coals are classed as house coal, and very definitely not for use in smokeless zones, as we shall see!

If you are reading this in England, from 1st May 2023 you won't be able to purchase either of these two fuels in

any case, due to new laws around carbon emissions. Wales and Scotland are not yet faced with the same laws, so one assumes they will still be available should you wish to use them, however it's possible they will naturally disappear through lack of demand, or the price will rocket as a result of low sales.

None of our testing team were going to say no to another day's steaming, especially since by this time the better weather had arrived and so we weren't getting cold in the process, and off we went to get fires lit and trains made up.

If you've been following this series at this point I'm sure you know how we ran our coal trials, so I won't describe for a third time how the bunkers were swept out, and how each engine used one fuel exclusively. Suffice to say that while we might not



have had thermocouples measuring temperatures or sophisticated weighing equipment to measure out the ash, we did our best to maintain constant testing conditions for the majority of each test.

Almost immediately both coals illustrated why they were not classed for use in smokeless zones, as the accompanying pictures show, leading to much joking about what might actually be in the coals, given the countries of origins of both!

Science of smoke

What, however, is 'smoke'? (Photo 23) Essentially it's unburnt fuel, be that coal or oil, and you'd be forgiven for counting the pennies falling out the chimney top, because essentially that's what is happening. Smoke is caused by the volatiles in the fuel being exhausted from the boiler before combustion has been completed, which happens within the firebox itself and stops once it passes into the tubes.

PHOTO 22:

What we likely won't have for much longer – good old Welsh Steam Coal.

PHOTO 23:

What we need to cut – very visible smoke on a traction engine at Rugby.

PHOTO 24:

Early tests with lump house coal did not help with the smoke issue...

PHOTO 25:

The larger firebox of a Garratt did not seem to help matters much...

PHOTO 26:

...not helped by a need to fill the loco's firebox before each trip due to firing difficulties.

PHOTO 27:

Once out on the line matters improved and became more transparent.

Photos by the author unless stated

23



24



In other words, smoke means you are wasting money.

In an ideal situation, you would have a locomotive firebox and fuel designed so that combustion of the fuel was fully completed in the most important areas of the boiler, such that absolutely nothing of a contributing nature rose from the top of the chimney.

The full process of combustion and heat transfer isn't really a subject for this article but if you want a really good explanation of how this all works, I can really recommend the short film *LMS Archive – Little and Often*, available on YouTube (<https://bit.ly/3WCF6aw>). Produced by the London, Midland & Scottish Railway a good many years ago, every word is still valid, and the principles are still applied by firemen today – I use them every year at the Talyllyn Railway.

In order to reduce the smoke, the process of combustion needs to be changed, which can be done in several ways. At the Talyllyn, we are well versed in giving 'top air' to control smoke, in stations mostly but on a few other occasions too. Top Air is literally what it says – air to the top of the fire, and what you are doing is changing the mix of volatile gasses and oxygen to promote combustion by opening the Firehole door.

This however should never ever be done when the locomotive is working, as it draws cold air over the firebed and chills tube ends – we've had two instances of this in our club now, leading to tubes leaking, so as you can imagine I'm rather keen to stamp out this bad habit.

There is an exception to the rule – I'm sure lots of people will jump to point out the mainline engines that run with fire doors open, and you'd be right, however! Mainline locos are fitted with brick arches and deflector plates, so incoming air is first directed down to the fire under the arch.

The purpose of the arch is to increase the length of the flame path, so increasing the time the volatile gases spend in the firebox, burning more of them, and so reducing the amount of smoke issuing from the chimney top. This is the second method of reducing emissions, but one which is rarely seen in miniature, and it's not easy to get right.

Little and often

Of course the old mantra of little and often does help, if there's too much coal in there to start with, then all that's going to happen is it sits there pouring out smoke, but over the course of the day's testing we were to discover that both of the tested coals were extremely difficult to control the smoke (**Photo 24**).

25



Later in the year we tried the 59 Class Garratt 'Mount Kilimanjaro' on the same fuels and had exactly the same problems with smoke (**Photo 25**), so we couldn't blame it on the small size of the Romulus firebox.

There is a particular problem with the Garratt though – it's impossible to fire on the run, as although it's a big engine, there's actually no room on the footplate to swing the shovel, absolutely no chance of taking a run up to get a throw to the front 16 inches away, and the coal bunker is not very accessible behind you.

Little and often goes completely out the window, the only way to fire it being to fill the firebox, so that we were starting each trip (**Photo 26**) with too much coal in the firebox, (leading to excess smoke from unburnt volatiles) just so that there was enough coal in the firebox to have caught so that when the long slog back to the station was started, the loco had a fire left in it to make the steam that was needed.

It's really poor firing, and the smoke is not something we're proud of at all, quite embarrassed by in fact, but she does complete a trip with a fairly clean exhaust (**Photo 27**), showing that the coal has by this point burnt

26



“Although it's a big engine, there's actually no room on the footplate to swing the shovel...”

through sufficiently to be able to clean burn in the volumes present.

But back to the testing day... Both Romulus engines did run well and there wasn't a particular amount of clinker present on either grate, nor was there much to be found in the front end on in the ashpan.

Neither engine produced much by way of hot cinders, in spite of some spirited running on occasion, but 'Dr John', which was running with its cylindrical perforated-plate spark arrestor around the blastpipe, was

27



noted to go off the boil after an hour or so.

The grate was clear of clinker and the ashpan wasn't full by any means, but investigation in the front found the arrestor to be thoroughly coated in dry soot, which had all but clogged all the holes and starved the draught necessary for steam production.

My Romulus 'Myglyd', with its loosely fitted horizontal wire mesh arrestor, didn't have so much of a coating over it. Following further trials later in the year, we came to the conclusion that my mesh was actually vibrating and shaking the soot off, whereas in Dr John with the vertical holes and a rigidly fixed tube, it was actually clinging to the edges of the plate, and building up from that until it blocked the hole.

The soot is the unseen side effect of the smoke that was billowing from the chimney tops, more of the unburnt volatiles again, and in fact come tube-sweeping time, we got much more from a run through than we ever did running on Welsh Dry Steam coal.

Soot deposits on tubes and plates reduce the thermal efficiency of the boiler, so a fuel that does this isn't really something to be promoted, you'll ultimately end up pushing the boiler harder and burning more fuel to achieve desired outputs. I have been reminded that in Part 2 describing our trials, I had forgotten to mention the ever-present almost chemical smell that accompanied the Wildfire fuel. With these two latest fuels though there was no chance of me forgetting the smell, best described as eye-watering, literally!

Smoke gets in...

These are not fuels for short-chimney engines – we found even with the Romulus and its tall chimney that you had a face full of the smoke for half the circuit, and it really was eye-watering at times.

Those who know our track at Rugby will know the long descent to the cutting, followed by the long steady climb back to the station. In order for big trains to make the climb, fires must be prepared on the downhill run, and if the wind was blowing the wrong way, the smoke curling off the chimney top filled the cab on every circuit. I ran our 7¼-inch gauge Royal Scot on one public running day burning one of the lump coals, and no matter which way I pointed the spark deflector, the smoke was in my face the whole day.

There is a new buzz phrase beginning to take off – "Polluting For Pleasure", and while it hasn't yet begun to be used towards railways, seemingly being focused on

motorsport for the time being, those dreadful displays of American Shays belching out black smoke will be playing right into the hands of those who would seek to stop us making any emissions at all.

I well remember a number of years at the Great Dorset Steam Fair where half the site was hidden by clouds of rolling smoke. For that very reason we should be looking for cleaner-burning fuels, and I would not at present be recommending either of these coals for use in miniatures based on everything we've found.

Some of our other club members have been using a fuel called Stovesse for some time, which is pure lump anthracite coal. Frankly it's an awful fuel in my opinion. There's something about it that every time I use it through lack of anything else, I end up with at least a bad headache if not a migraine, and my wife Holly who acts as train Guard for me also reports that it gets in her throat and gives her a cough for a week after.

I have found it to be the worst-clinkering fuel I've ever come across, and I've had some pretty bad days at the Tallylyn, even recently. At Rugby we had a public running session during the year when someone ran the morning on Stovesse, and then during the afternoon our junior member was driving (and very skilled he is) but struggled for steam despite using proper coal. We pulled him off early, and **Photo 28** and **29** show exactly why! In all our experiments we'd never had this much clinker, but pretty much the whole of this 8 x 10-inch approx grate was solid clinker after four hours of running.

The coal is mined in South Wales and falls into the Smokeless category so is still available after 1st May 2023. At the time of writing, the tonne rate appears to be more than for Welsh Dry Steam coal, and more than the modern alternatives, so it will definitely be worth doing some research before you buy.

Cheesed off

Out in the world of heritage steam, other fuels have been tried, to greater or lesser extents, some successfully, others not so. One which has given me grief is the infamous yellow bricks (**Photo 30**), and I did promise our editor I wouldn't use my usual description, as it was unprintable!

Classed as a bio fuel, they are made from the remains of pressing rape seed oil, so high on the green credentials list, and previous articles have appeared in **EIM** and its sister magazine *Narrow Gauge World* on their use (*see note at end of feature – Ed*). They are only available in one size which is somewhat larger than



PHOTO 28-29:

An anthracite lump coal created some impressive levels of clinker.

PHOTO 30:

It's obvious why this rapeseed oil-based coal has been dubbed cheese... Photo: Harry Billmore

PHOTO 31-32:

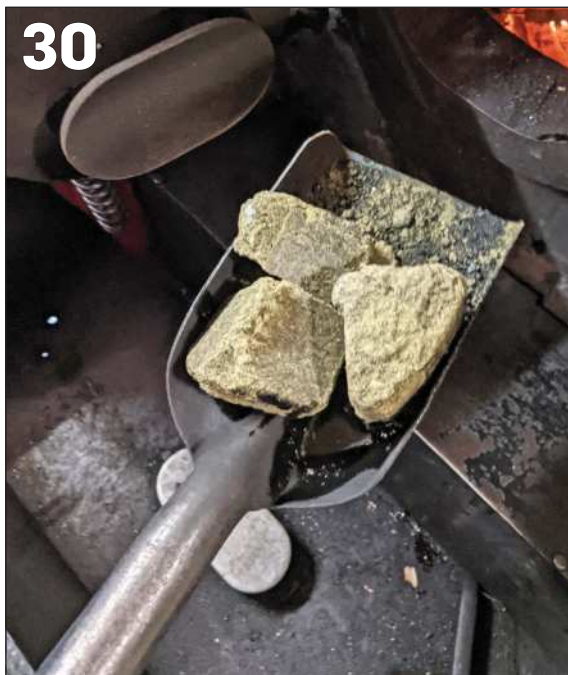
Soot was an issue when the 'cheese' was trialed on the Tallylyn Railway.

suits any of our engines, however my last encounter with them was late Summer 2022 in Wales.

Holly had the misfortune to be Guarding a train that was fired on the yellow bricks, and 100ft behind the loco had a most unpleasant day. While the loco crew were busy shovelling it by the bucket full, considerable foul-smelling fumes were meanwhile filling the train as the exhaust steam and smoke was drawn down by the passage of the train.

In all the reports of the trials of this fuel, I've never yet seen anyone print what the passengers might think of the fuel, but certainly from this day's experience it was not good. As is customary the loco had spent an hour or so on lay-over between trains, and during this time proceeded to fill the offices, museum and café with noxious fumes which took some considerable





time to clear after the train had left. The following day a notice went up prohibiting its further use...

My experience with the yellow bricks was in dealing with the aftermath. Traditionally at the Tallylyn we sweep the boiler tubes on a roughly three-week cycle, more if it's deemed necessary or if there are hands available looking for jobs to do.

I had a day firing No. 6 'Douglas', a week after it had made a trip up the line on the yellow cheese, and about nine days since tubes were swept. No 6 has a reputation for steaming on a candle, two if it's a heavy train, but on this day it was having none of it.

Despite the efforts of myself and my experienced driver, the pressure gauge stubbornly refused to clear 125psi despite a larger than normal fire, and at times we were mortgaging water in between sections of

"By the end of two trips, I could truthfully say it had been a tiring and stressful day..."

mortgaging steam. By the end of two trips, I could truthfully say it had been a tiring and stressful day, but why?

The day after, I was rostered for a single trip, late start, so with the engine in the bottom of the loco shed and free access to the front end, I resolved to go in early and sweep the tubes, even though we were only 10 days in. **Photo 31** and **32** show the aftermath, and while they don't look like much, the amount of soot that's there is more than I have ever pulled out after a usual three-week stint.

When I started, the lower tubes in the front tubeplate were about an inch clear of the smokebox char, and you can see by the time I'd finished, it was halfway up the tubes. I hope you can see on the printed picture in the magazine how much was deposited in the firebox as well, and is lying on top of the previous day's fire which I hadn't yet removed.

A good portion of this soot will have been deposited by the clouds of smoke coming from the yellow bricks, as I mentioned earlier about how smoke is unburnt volatiles. Needless to say, having swept the tubes, Douglas was back to steaming on a candle, so much so that I almost over-cooked it leaving Tywyn Wharf and cresting the top of the bank to Pendre.

Conclusions

So after all our testing, what conclusions did we draw? Well we know the days of Welsh Dry Steam Coal are numbered, more's the pity. Whether or not the one remaining colliery at Fros-y-Fran gets the three-year extension it's asked for is immaterial, we'll just find ourselves in exactly the same place as we are now, which is why we at Rugby MES refused to pay the inflated price for Welsh Dry, and decided to experiment with cheaper Ovoids, albeit being careful to choose ones which the heritage sector had already had good results with!

Our experience with the imported and domestic lump coals were

generally positive, but the issues of smoke production could not allow for these fuels to become the norm. Given the ban coming in to force in England we wouldn't have been able to continue with these anyway, and in fact during writing this I've searched for it to be met with the phrase "limited stocks, call to enquire"!

Our experience with the Ovoids has been very positive on the whole. The Trevithick Welsh Steaming Ovoids were a bit of a disappointment, but largely followed the experience in the preservation sector. I still suspect that the reported Lime binding agent was the largest factor in the failure to make steam, although I don't have access to the equipment necessary to prove this scientifically. Once again in researching supplies for the 2023 season, I have in any case been unable to find a supplier.

Our experience with the ECoal 50 that we started the 2022 season with was, from a fireman's point of view, very positive indeed, and I think the only thing to let it down was its cost. At the time it cost us around £17 per 25kg bag, and a year later it's listing at closer to £20 – considerably more expensive than we had been paying for Welsh Dry, once you factored in the increased use as well.

The Wildfire Ovoids performed extremely well, and at the current time are priced at around £18 per 25kg bag. Given how little clinker they produced, we expect to be able to run a full day on this fuel and not have to worry about clinker production. Once the source of Welsh Dry Steam Coal has dried up, be that in 2023 or 2026, I believe this is the best currently available replacement fuel, for locos where there is no other option.

Are there other alternatives? For the very largest of locos, such as the Garratt Mount Kilimanjaro and the two Baldwin locomotives we are currently building, oil firing is a further alternative we are considering. We have a design for a burner which



33



we intend to manufacture and trial – it's an old design and probably not what we would use in an engine, but the experimenting will be worth the time just for the educational value.

Liquid alternative?

'Oil' as a fuel will be around for many years yet, and is a much more controlled substance than coal, so results should be more consistent, more of the time. There are specific operating issues to overcome, such as a need for atomisers to create the vapour, which is done with steam once hot but requires compressed air (or a stationary steam plant or spare locomotive!) when lighting up, and of course it won't work for our smaller engines.

This would provide us with a good solution to the smoke issues with the Garratt as you would be able to control the burners and heat output on demand, as required – in fact that engine was built as an oil burner, her sister at the National Railway Museum is still fitted with the equipment.

There is of course bottle gas, much used in America. Many people do run with it, however there are a number of issues with it that worry me and have never, in my opinion, been clearly addressed. For one the fuel is invisible, denser than air, and highly flammable, and the consequences of a

leak on a partially enclosed footplate like the Garratt worry me somewhat.

Perhaps the biggest concern is the danger of carbon-monoxide poisoning, which can happen if the burners are not correctly set up, and with the chimney low down in front of you, you'll be getting a face full of exhaust fumes all day.

There's also issues surrounding the storage of bottle gas, which must be a pressure vessel tested to quite high pressures. Building such a vessel to fit in the coal space of an LMS 4,000 gallon tender, even in 7¼-inch gauge is going to be impossible if it's to have any duration, and at Rugby at least we don't have the room to be hauling round a baggage car just for the fuel. Other engines like the Romulus and the Shay that we run, do not have any suitable spaces to fit a pressure vessel in anyway.

For oil which is not pressurized, building a suitably shaped tank presents no problems. That being said, I'm not at all convinced that a small engine would run on oil, lacking firebox volume, so such engines may be forced to burn anthracite anyway.

I believe the photos I've used to illustrate this series of articles have clearly shown the products of combustion. There has been no exaggeration for effect or to prove a point, we genuinely did just get those

34



PHOTO 33:

Inspection lamps burn well but are not a potential sustainable fuel...

PHOTO 34:

Experience in the heritage rail sector, such as here with the Talylyn Railway's 'Douglas' will be key to aiding the search for viable future fuels.

PHOTO 35:

What in future will be creating that familiar hot orange glow we all love remains open to question at present...

four or five pieces of clinker from the Wildfire, and we really did get a massive almost grate-sized piece of clinker out of the Shay from running on Stovesse, and both were in steam for the same amount of hours.

Not to be ignored

Going forward, alternative fuels will be required, it's unavoidable. One Talylyn fireman did try an alternative all on his own, but that didn't come off too well... **Photo 33** shows what was an inspection lamp that was found in a firebox one morning when the next fireman came to clean out before lighting up – two round trips had not done it much good!!

STOP PRESS! Just as I was about to email this to the editor just in advance of the press deadline, my enquiry with a coal merchant to supply us with a ton of Welsh Dry Steam Coal for the 2023 season came back. Short answer, not enough available to fulfil current contracts, so new orders are unlikely to be met. That explains the note on the website to call where before it listed a price. Looks like we'll be on alternative fuels again this season... **EIM**

■ Editor's note: In fairness to the rapeseed oil based 'Cheese', which actually goes by the name of Green Coal, this is not a 'finished product' – its makers have emphasised that it is still under development and not on general sale. As detailed in an in-depth feature in the January-February edition of our sister magazine *Narrow Gauge World*, extensive trials have been conducted with this fuel on a number of heritage lines with the makers working through each issue that arises, with high confidence of finding solutions. It's very much a case of 'watch this space'!

EIM will continue to highlight measures and developments to make our hobby more sustainable and we will also soon be bringing you a feature on revolutionary new technology from New Zealand that among other things claims to achieve that goal of complete combustion within the boiler...

35



An improved Schools – building a Roedean

Nick launches into his 3½-inch gauge locomotive project, this month analysing what he has and tackling the driving wheels.

BY NICK FEAST Part Two of a short series

I had a few other projects in mind when I bought the part-built Roedean, so I wanted to make the construction of this locomotive as speedy as possible. **Photo 6** shows what I started with. My purchase also came with both the published sets of drawings for a 3½-inch Schools model, more on this later.

I checked the availability of laser-cut parts from Malcolm High, who was then running Model Engineer's Laser, and there is a good range available, so I bought as much as possible from this source. Most of the valve-gear parts, the connecting rods, reach rod, cab, steps and footplate sheets and all the tender plates were duly delivered, and proved to be precisely made and saved much cutting and filing.

The Schools is of course a three-cylinder loco so there are 50 per cent more valve-gear parts to make than on a two-cylinder engine. Any saving in time was well worth the cost in my opinion, the aim was to get the loco completed and running in the shortest possible time, and to improve on the published designs where practical. Another requirement was that my model must have the Bulleid-Lemaitre multiple-jet blastpipe and chimney, which is rarely reproduced in model form.

Worth keeping

Having taken delivery of the laser-cut parts I also discovered a few other items in my castings box under the bench that were suitable for this model, such as a frame stretcher and a steam-brake cylinder. Unfortunately I had no cylinder castings, this needed some research.

Photo 7 shows some of the laser-cut parts and some of the fabrications that go into making the valve gear. None of it is particularly difficult but the outside slide-bar brackets do need to be accurate or there will be trouble ahead with bits clashing together.

I should point out at this stage that having studied both sets of drawings it was clear that LBSC's piston-valve design was far better described than

PHOTO 6:

Beginnings of a locomotive. The tender chassis is complete and fitted with the disc-type wheels specified by LBSC although the full-size loco has a ten-spoke 4ft diameter wheel. Chilled area of casting visible on the left-rear driver – it was impossible to machine even using carbide tools.

PHOTO 7:

Some of the laser-cut parts and some home fabrications. The outer and inside expansion links are different. Much time was saved but plenty of fabrication and machining was still needed.

Photos by the author

the Jackson slide-valve option, even though I would much preferred to have used non-prototypical slide valves. LBSC's design is printed on 13 sheets of A1 paper, every item is drawn individually and of course there are the 'words and music' to go with it. The Jackson design is on seven sheets of half the size and needless to say is much more difficult to follow, even for someone who has completed five locomotives to date!

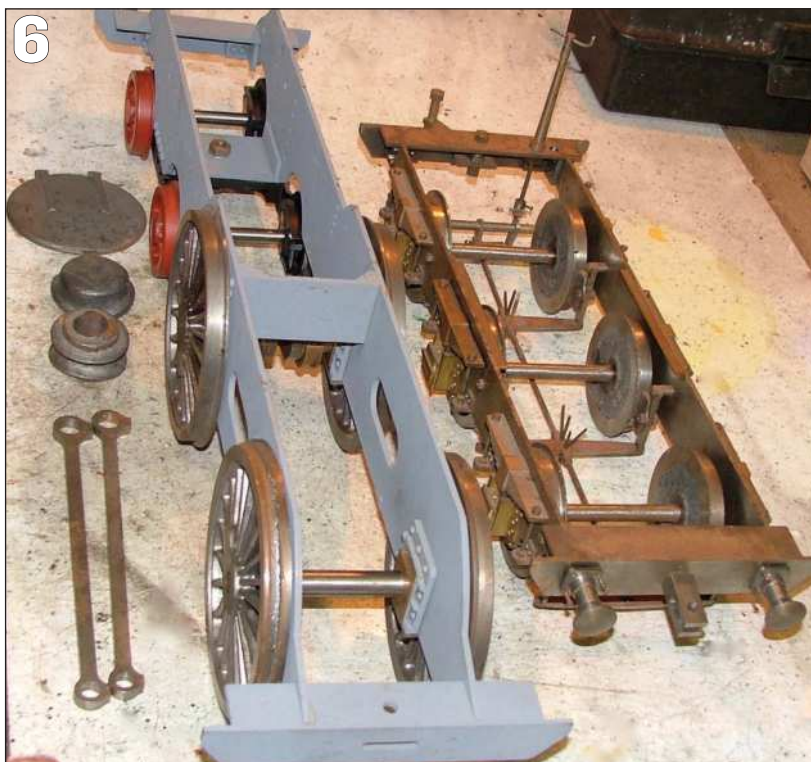
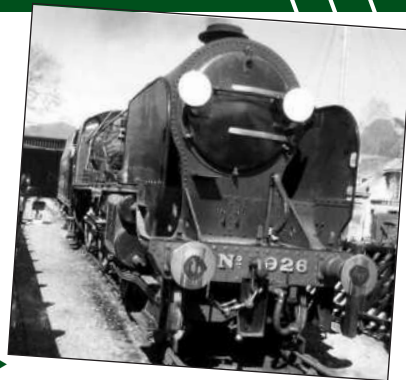




PHOTO 8: All the loco's cast iron wheels were turned down or ground off to accept mild steel tyres. The tyres were machined from thick-wall steel tubing.

PHOTO 9: There were no dramas in the tyre fitting process. As long as the tyre is evenly heated to a straw colour, 230-240 degrees C, the wheel will drop in easily.

PHOTO 10: The wheel after air-cooling. Quenching is not required. Note the lack of balance weights.

PHOTO 11: A slightly oversized mandrel was made and then finish machined to the hub diameter. All the wheels were then machined without removing the mandrel to give perfectly true wheels.

PHOTO 12: The 6ft 7-inch coupled wheel of 'Cheltenham'. The balance weight is opposite the coupling rod pin.



The biggest problem with the Jackson design however is the boiler, which I will discuss in more detail in a later part of this series. The LBSC boiler is not perfect, being designed with no cladding or insulation whatsoever, but it does have adequate stays to make it strong enough for the intended operating pressure of 80psi.

The first stage of the build was to check what had already been made. When buying a part-built model you must take nothing for granted and check every dimension. I once bought a Maisie chassis, which appeared to be well engineered until I found it would not fit on the track. The builder had set the wheels with a back-to-back dimension of 3½ inches instead of gauging them to that dimension!

Chilling discovery

The axlebox-to-hornguide fit of the Roedean needed easing and radiusing to allow for proper suspension movement and the crank was drilled and pinned through the webs for extra security. The main issue was that one of the main driving wheels was not fully machined owing to a hard spot in the casting. Castings are expensive and these were particularly nice ones.

The spoke profile was good and no balance weights were fitted which gave me the opportunity to fit the correct style of weight. Most castings I have seen have the weights in the wrong position on the driving wheels, set for a two-cylinder locomotive not a three. Even the Hornby model has this error!

To overcome the chilled section of casting I first had to grind off the hard spots and then machine down the castings to allow a steel tyre to be shrunk on. I also managed to break off a section of flange when dismantling the bogie wheels to ease the axlebox fits, so I decided to fit steel tyres to all the wheels.

Photo 8 shows one of the driving wheels, a bogie wheel and a tyre. There needs to be an interference fit of one thou per inch of wheel diameter between the tyre and wheel.

Photo 9 shows the tyre being heated up by the propane torch; I have

used an old storage-heater brick, which has the advantage of being pretty flat and smooth. Heat the tyre evenly to a straw colour and the wheel will just drop in – it turned out to be one of those jobs that was easier than expected, which was a nice change! Just allow the wheel to air-cool and the tyre will be there for keeps.

Photo 10 shows the tyre in place, while in **Photo 11** the wheel is bolted to the mandrel held in the self-centring four-jaw chuck ready for machining. I have taken a skim across the face of the wheel and will replace the triangular lathe tool with a button tool of the correct radius to machine the tread and flange profile.

Photo 12 shows the right-rear driving wheel of the full-size Schools class loco 'Cheltenham' with quite a lot of useful detail – the position and size of the balance weight, the spoke and tyre details, leaf springing and brake block. The nut and pin retaining the coupling rod are clear. The pin is a taper cotter with the end split open.

Old but still good

Photo 13 shows the same wheel on the model. I made a crescent-shaped metal plate of the correct profile for the front of the weight and attached a thick piece of waxed card to the back of the wheel. I mixed up some glassfibre resin and poured it into the space between them, keeping the wheel positioned so that the surface of the resin was in line with the top edge of the weight. I added some black glassfibre pigment from a previous project (about 50 years ago!) so this made painting a bit easier.

In **Photo 14** is the left-side driving wheel of Cheltenham, showing the much larger balance weights which are ahead of the 180-degrees position relative to the crankpin, where as on the opposite side the weight trails the 180-degree position. This is to partially balance the inside big end and con rod. **Photo 15** is the right-hand driver on the model. **EIM**

■ Next time, Nick describes how he fabricated the cylinders for his model.



PHOTO 13: Equivalent wheel the photo 12 on the model. Before completion Nick will add the oil chamber to the boss on the coupling rod.

PHOTO 14: The driving wheel balance weights are clearly offset to the outside crankpin to balance the inside rod and big end. Both main axles are leaf sprung; many 4-4-0 locos combined leaf and coil springing.

PHOTO 15: Model driving wheel. Despite the hard spots castings were clearly produced from excellent patterns and to scale. When the loco has been track tested the return crank will be pinned to the crank pin.



TIPS FOR MODEL ENGINEERS

Not a permanent parting...

BY HARRY BILLMORE

This month I offer one of those quick 'obvious once you are shown it' tips for a beginner machinist. When parting off parts with a hole down the middle on the lathe, especially small parts, it is handy to use a catch pole to stop said part disappearing forever into the chip tray with all the swarf.

This can easily be accomplished by holding a piece of rod by hand. If the component you are parting off is particularly small, or you need two hands to part off, then a piece of of bar held in the tailstock chuck and poked down the centre hole works very well. **EIM**

Do YOU had a useful tip to offer your fellow model engineers? Send it to editor@engineeringinminiature.co.uk

RIGHT: It's not much use spending time making a part if it disappears somewhere inaccessible, or even worse hidden, when you part it off. A simple rod down the hole prevents expletives in the workshop...

Photo by the author



WHAT IS AVAXHOME?

AVAXHOME-

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Going round the bend...

Warwick provides his thoughts on a potential issue that many loco owners possibly don't realise, but which can cause frustrating derailments on the track.

BY WARWICK ALLISON

To start with the problem – our 5-inch gauge club track has some quite significantly sharp curves on its route. The sharpest is of 8½ metres radius and many of the published designs just cannot accommodate such tight radii. In many cases it seems they are designed best to travel in straight lines!

Certainly many prototype locomotives have large leading bogie wheels that are very close to both the frames and cylinders. Making them all to scale is virtually a guarantee that they will have trouble on the bends.

Not only are there the sharper curves we need to deal with but also out-of-scale wheel flanges. Then there is the blessing (or curse) of gauge widening to deal with. And finally we have track vertical curvature (or perhaps dips and peaks) affecting our locomotives' trajectory.

The theory

Simplistically, railway wheels are subject to forces in both the vertical and lateral planes. The lateral forces act upon the flange and root radius and have a tendency to lift the wheel thus producing a derailment.

The vertical force which bears down upon the wheel balances the derailing tendency and keeps it on the rail. The vertical force is from the mass of the locomotive while the lateral forces are higher when curving due to centripetal forces.

The ratio of the two forces is called L/V (L over V) and in the prototype world if the ratio exceeds 0.8 the derailing tendency is considered to be at a higher risk. There are many factors involved in this, but this simple approach gives us the basis for our assessment.

As well there are vertical curves. These may be changes in grade or just high and low spots in the track. Either way the loco has to negotiate them and the suspension arrangements are critical when negotiating at high speed to avoid unloading a wheel. As one could imagine, it is worse if this is also on a curve as a twist will also exist.

The aim

Ideally we want to ensure our engines can negotiate the curves (whether vertical or horizontal or both) while maintaining adequate wheel loading to avoid derailment.

FIGURE 1

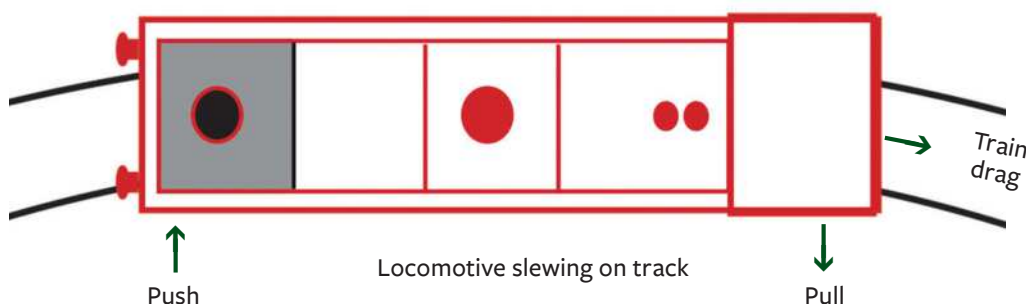
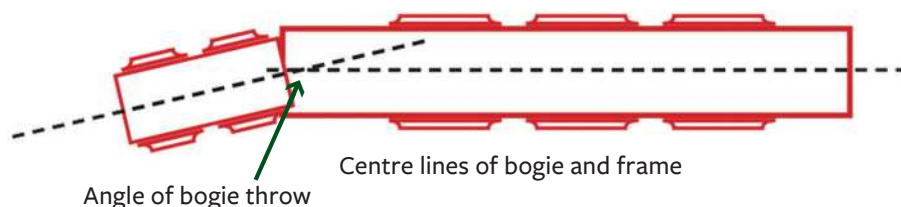


FIGURE 2



"The lateral forces act upon the flange and root radius and have a tendency to lift the wheel thus producing a derailment..."

Things to be Aware of

If the engine has a long wheelbase this on its own will restrict the curvature it can travel around. In Australia our wheel standards have a 4mm thick flange which allows us to reduce the intermediate wheel flanges to 3mm to provide clearance for these situations. However the UK standards are finer and reducing locomotive wheel flanges smaller than the current 3.2mm is probably only sensible if the wheel tyres are steel, otherwise they could be a bit weak.

Of course there is always the flangeless option too. It might be thought that some sideplay will assist, as it does, but unless specially designed for it, this is more likely to

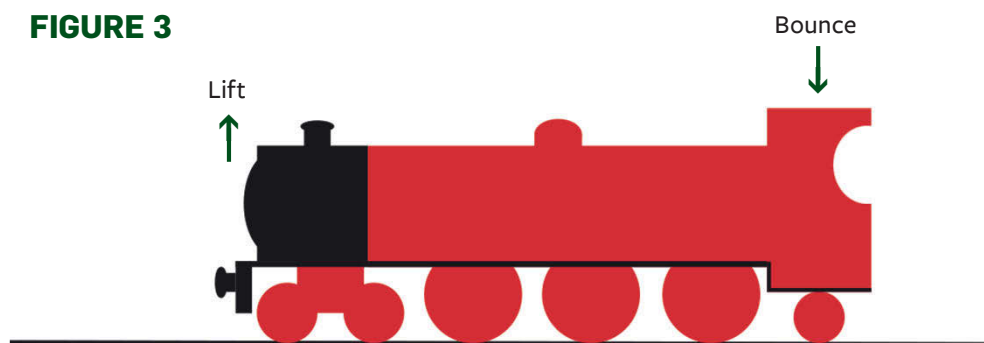
clap out your coupling rod bushes very quickly!

When a loco is running light around a curve it is most likely the wheels are all riding along the high rail. However when it is pulling hard, the load can pull the rear of the loco toward the inside of the curve.

This skewing of the engine can increase the angle between the engine's main frame and the front truck. If you have built your sharp curve with gauge widening this skewing will actually be worse, and the increase in the angle is quite surprising. So gauge widening is not the panacea one may think.

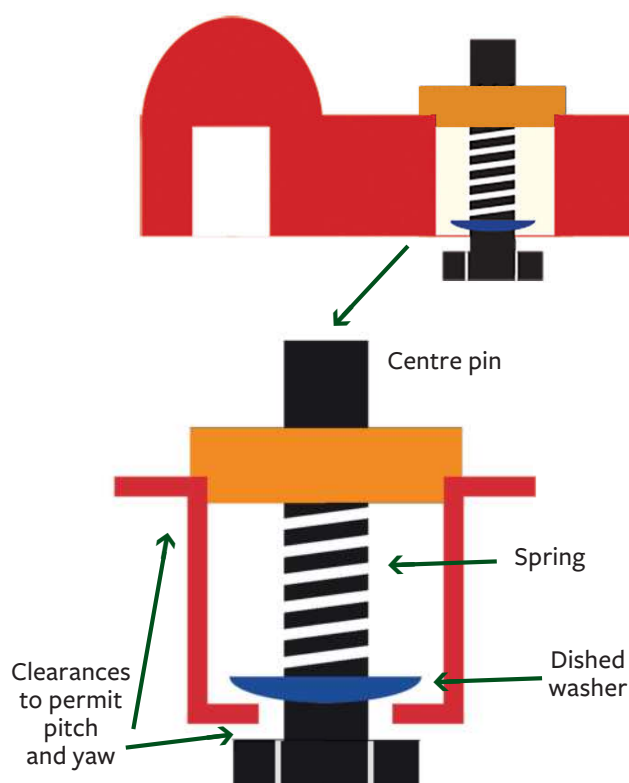
If the front bogie contacts the frame, or cylinders, or binds in the

FIGURE 3



Engine bounces due to uneven weight distribution

FIGURE 4



slot that restricts its sideways movement, the lateral forces greatly increase and also the risk of wheel lift.

The same applies to the rear truck although unless the engine frequently runs backwards, the impact is not as great. Nevertheless the rear truck should be checked for all engine dispositions to ensure it can operate and move freely.

Testing for issues

It is possible to test your locomotive before taking it for a gung-ho romp at high speed around an unknown track.

Firstly find your sharp curve and place the loco within it. It could be a set of points.

Push the front of the locomotive to the outside of the curve and pull the rear of the loco to the inside of the curve. (Figure 1) This will produce the greatest displacement of the front bogie or pony truck (Figure 2).

If this shows that the bogie or pony truck hits the cylinders or any part of the locomotive, or has a tendency to lift the inner bogie wheel, then there is a problem.

Secondly (this can be on straight track) bounce the locomotive by pushing up and down on the rear of the cab while watching the front bogie (Figure 3). If there is significant movement and especially if the bogie wheel lifts, we need to do something.

Rectification

Obstruction at the front pony truck or bogie can be addressed in a number of

ways. It will be different for different locomotives and you may have to compromise on some of your model's prototypical features.

If the sideways bogie movement is restricted by the sliding block in the bogie frame, then lengthening the slot or reducing the width of the block are rectification options.

Side-control springs can also be the problem. I suggest the test is best done without side-control springs as these can unduly increase lateral forces. If removing the springs solves the problem, you need to consider springs that do not fully compress or are softer.

Leaving these springs out altogether is usually not the end of the world. Never consider that the use of side-control springs is there to keep the wheels from hitting the cylinders! Your bogie must be able to move to a position it needs to be without unduly increasing lateral forces!

If the bogie wheels do strike the cylinder then consider using slightly smaller diameter wheels. Perhaps you need a running and a display bogie! Repositioning the bogie forward can also assist and may not be noticeable. This may need an altered block or bogie frame slot. Note too that bogies can also be obstructed by lubricators!

The corollary is that the back of the wheels may contact the frames. Larger frame cut-outs may be needed, especially for the leading wheels. Make sure any cut-outs will accommodate any vertical movement of the bogie too.

If bouncing the locomotive lifts a leading bogie wheel, this shows that either the locomotive springing needs adjustment, or there is inadequate vertical movement in the front bogie or pony truck.

Taking the springing first, a locomotive needs to sit 'squarely' on the track with a reasonably consistent axle load across all driving axles. If the springs on the centre axle are tighter and thus carrying more weight, the locomotive can pivot back and forth on this axle.

Evening up the spring adjustments

can improve this immensely. This is a fairly straightforward process on locomotives that largely support themselves on their driving wheels, such as 4-6-2 Pacifics, eight-coupled and even 4-4-2 Atlantics.

Locomotives that rely on the front bogie for balance such as 4-4-0s and 4-6-0s are a little different. These will have an increased loading on the leading driving wheels relieved by the loco weight on the front bogie. These types (especially 4-4-0s) also have a tendency to 'sit down' at the rear when starting a heavy load and this also tends to lift the front.

The arrangement of many front bogies is really relying on the locomotive frame bearing down on it at all times. If it does lift off, then the only thing preventing derailment on a curve is the bogie mass itself, and this is usually insufficient. From my experience, for a 5-inch gauge locomotive you need at least 5kg per axle, and 10kg is good.

Those bogies with large centre blocks often limit any pitch and yaw the bogie can do. The bogie really does need to be able to rock sideways and lengthways.

Make sure your blocks are not so large and precision made that this movement is inhibited. This can be done by having a relatively thinner block and no side control arrangement that prevents such movement. I prefer to have a spring (Figure 4) that pushes the lower part of the bogie downwards so that even if the loco frame lifts off the bogie, there remains a useful downward force to keep it on the rails.

The lower part of the spring should act on a dished bearing along the lower bogie slot that ensures the downward force is applied irrespective of the bogie orientation. Make sure that your nut holding the bogie on will not lower too close to the track if the front of the loco bounces down! There could be a potential collision here with point rails and any other mid-track structure.

Our outcome

Hopefully by making these assessments, one can better assess whether a locomotive can be safely operated on the tighter curved and undulating track. No doubt, however, purists will object to such non-prototypical arrangements! I suppose they will restrain their operations to prototypically straight track!

It is common to find that a loco works fine on its home track, but not on a visit to another track. It's difficult to predict all track conditions that are likely to be experienced but having an understanding of what the problems could be should put one well on the way to avoiding such issues. **EIM**

"If it does lift off, the only thing preventing derailment on a curve is the bogie mass itself, and this is usually insufficient..."

Diagrams by the author; redrawn by Andrew Charman

A strange way to start the year...

Harry beats the boredom of working at home by going on a couple of working visits as the Fairbourne Railway's workshop is reroofed.

BY HARRY BILLMORE

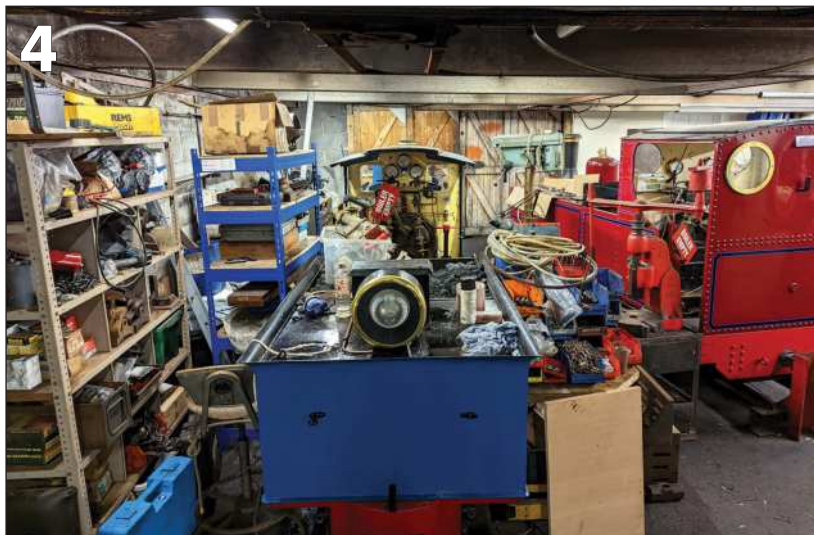
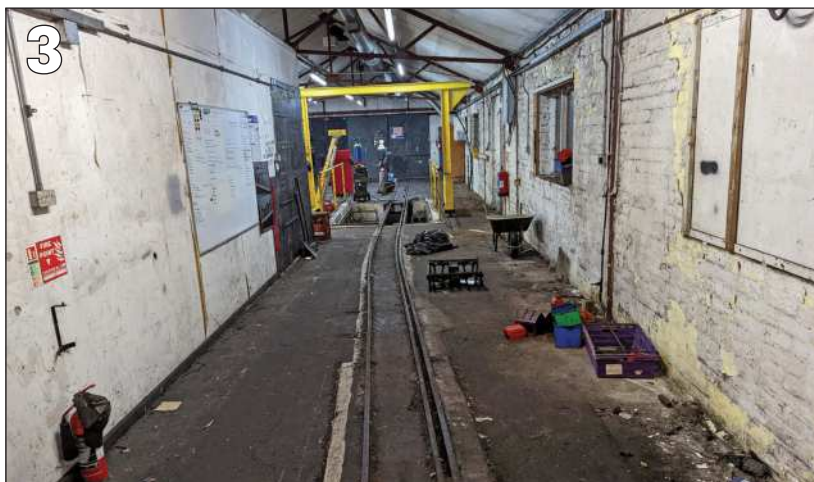


PHOTO 1:

Yet another vesconite bearing failure, this one also pressed out with gentle finger pressure.

PHOTO 2:

Measuring up Russell's rods with the bushes removed to assess which were correct.

PHOTO 3:

Most of the Fairbourne workshop stripped out ready for the new roof.

PHOTO 4:

As much of the contents of the workshop squeezed into the running shed as possible.

Photos by the author

The new year in the workshops of the Fairbourne Miniature Railway on the mid-Wales coast began much as the previous year had ended, with a bit of work being carried out on our 6-inch scale Welsh Highland Railway-style 2-6-4T 'Russell' alongside an awful lot of tidying up and cleaning!

The activities on Russell involved the final measuring up to allow me to work from home while the workshop is out of action due to having a new roof put on it. This first involved pressing out the vesconite bushes from the loco's rods. Most of these came out extremely easily with a bit of gentle pressure from my fingers – only a couple needed a couple of light taps with a hammer to get them out and one of them fell apart in my hands as I pushed it out...

With the bushes removed I could set about measuring the hole centres on the rods. These turned out to have been originally beautifully machined and measured up within 0.001-inch of each other side to side.

No option but new

Unfortunately however, due to the 1.25mm difference between the horn-guide centres between each side on the leading axle combined with the incorrect quartering previously discovered, the right-hand side rod has been worn beyond recovery.



Combined with the crack that is propagating from the weld where the grease nipple had been moved has necessitated the making of new rods.

To correct for the 1.25mm horn-guide centre error, I will be making an eccentric bushing for the right-hand side leading coupling rod eye, so that when the 10-year overhaul of the loco happens and the horn guide centres are corrected, I can then simply make concentric bushes and all should hopefully be well!

What followed was the more mundane task of clearing the workshops ahead of the roof renewal – a lot of moving racking, discovering interesting things that have laid undiscovered for some time, having a big clear-out which made our scrap man very happy and removing a small stud wall. With most of the small parts moved into the running shed part of the building (this has a good and newer roof) and stashed around the two locos that are stored there I could then move on to building a cover for the pit. This had to be able to take a scaffold tower so I built it out of old rail and covered it with chequer plate and 4mm steel sheets that I had to hand.

Working from home

With all of this complete I then went home to set up my remote office on the dining room table and set about the huge amount of design work backlog and other paperwork that has built up over the past months.

I soon realised that I needed

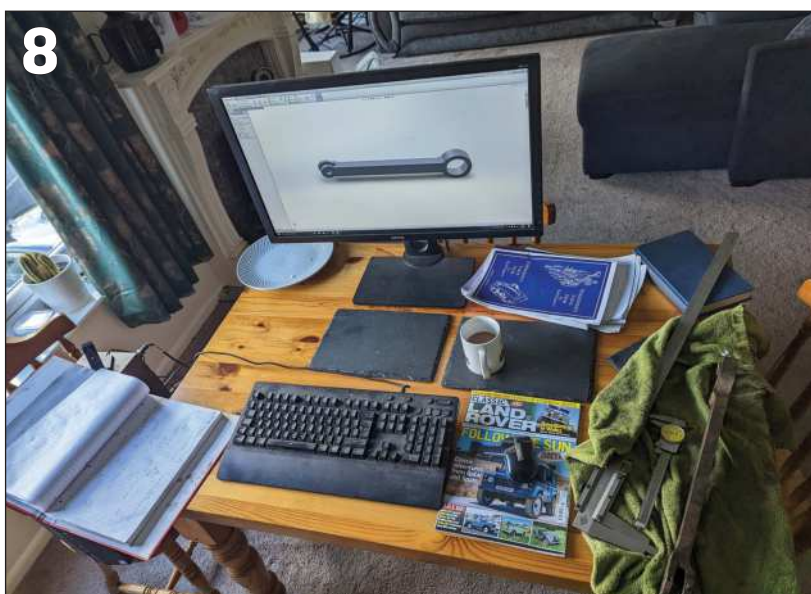
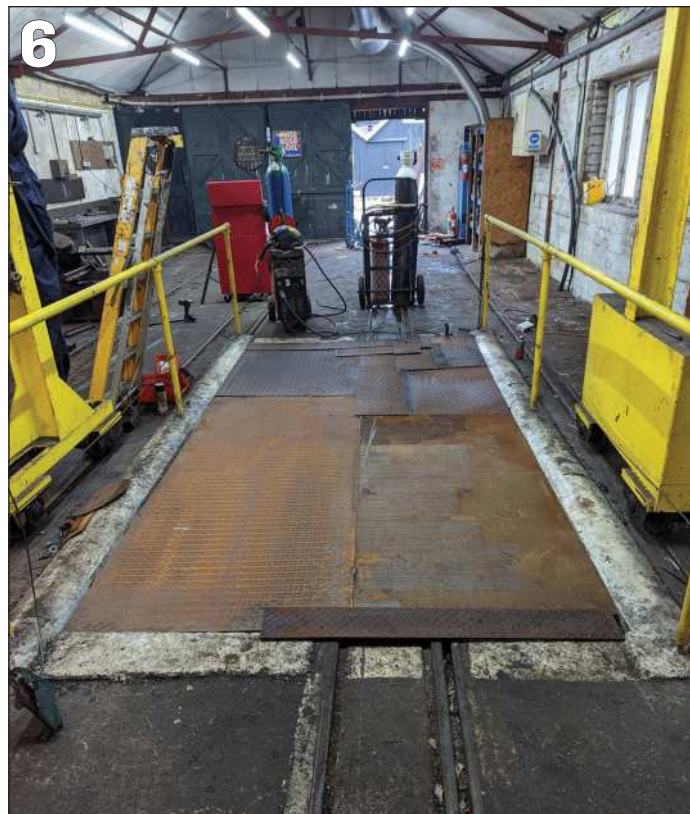
“Having a big clear-out which made our scrap man very happy...”

PHOTO 5: The framework for the pit cover being installed.

PHOTO 6: The pit cover complete.

PHOTO 7: The workshop after clearing, with an extremely bare and suspiciously spacious look.

PHOTO 8: A bit of a change, working from home doing CAD work for Russell's new rods.



9



some more measurements from the chassis of our currently under overhaul North Wales Narrow Gauge Railway-style 0-6-4T 'Beddgelert

than I had already taken. So I popped back over to Fairbourne and used the trick of holding a known measurement against an item and

PHOTO 9:

A handy trick to assist with measuring and drawing up items is to hang a known measurement on it and take a square-on picture to insert into a CAD file.

PHOTO 10:

Beddgelert's boiler in Boston Lodge works having been retubed, a new fusible-plug boss welded in along with re-sighting the clack bosses.

PHOTO 11:

Yeo sat in some very rare January sun midway through its annual boiler inspection.

PHOTO 12:

An attempt to re-use a gasket has unfortunately failed with this little wisp, not enough to fail the annual exam, but it needs rectifying before going into traffic.

taking a square-on picture of it. This then allows you to insert the picture into a CAD program on the computer, scale it to the known dimension and use that as a reference for drawing from.

I did manage to escape from the office on a couple of occasions however. The first was to go up to the Boston Lodge Works of the Ffestiniog and Welsh Highland Railways to inspect the work that has been done on Beddgelert's boiler.

I met up with our boiler inspector and witnessed the 1.5-times working pressure hydraulic test. As is usual with the FF&WHR the workmanship on the boiler is extremely high – it has involved a full re-tube, a new fusible-plug boss welded into the firebox crown and a pair of clack bosses welded onto the barrel in a place where they will not foul the saddle tank.

Cutting out the cut-outs

The last is to remove the complicated cut-outs that were in the tank to allow the clack pipework to run around the side of the boiler and join at a T-piece on the top of the barrel and enter there.

The latest modification should have both a benefit in terms of a simpler tank construction and put the relatively cold output from the injectors into the barrel at an equally relatively cool point, hopefully avoiding as much thermal shock as possible.

I also had to go back to Fairbourne to complete the annual boiler inspection on our Lynton & Barnstaple 2-6-2T 'Yeo', which thankfully passed with flying colours, I had replaced the old Nabic safety valves with a pair of Bailey valves – these are much easier to



11



12



13



14



service and feather nicely before lifting, which the Nabics never did.

I had another trip out to the Ruislip Lido Railway, which is based, surprisingly enough, at the Ruislip Lido in north west London. This is a really nice 12-inch gauge line running three quarters of the way around the lido and has an impressive collection of locomotives and rolling stock, well worth a visit if you are around there (www.ruislipidorailway.org).

User-friendly

The reason for my visit was that the Ruislip line has a 12-inch gauge tamper, bought from a firm in Austria. It is an extremely useful piece of equipment that reduces the amount of back-breaking packing by either shovel or Kango hammer,

I had gone down to look at it to potentially purchase one for the Fairbourne, but hopefully instead the two railways will be able to come to a mutually beneficial arrangement where we can hire the Ruislip example for our track work occasionally.

I have also managed to bring my 7¼-inch gauge Holmside locomotive home to my own workshop so I can finish off the plumbing on it. This required some careful planning, but with the stand I built a little while ago and some careful parking to avoid dropping the car off the edge of a wall, the task actually went remarkably smoothly!

So with all of this happening and me working from home, in the process confirming my long-held suspicion that I would never be able to work in an office all the time, it has definitely been an odd start to 2023!

EIM

■ The Fairbourne Railway's 2023 operating season begins on 19th February for school half-term week, followed by weekend running from 19th March. More details can be found at www.fairbournerrailway.com

PHOTO 13: A pair of new safety valves, in Harry's opinion a much nicer design than the Nabics ones that were on it, mostly for their ease of maintenance.

PHOTO 14: Ruislip Lido Railway is having a major relay on new rail with recycled plastic sleepers, mainline specification units cut into thirds.

PHOTO 15: A 12-inch gauge tamper at Ruislip, the reason for Harry's visit – with luck this will be the start of further collaboration between the two railways.

PHOTO 16: The laser used for levelling and setting the gradient of the track at the Ruislip line.

PHOTO 17: One dark evening Harry's Holmside made its way into his workshop, negotiating the steep drive and a bit of a weird corner on the decking was a little interesting...

16



15



17



CNC machining – a skilled process

I write in response to My Drake's letter published in the February issue, regarding creating separate classes of awards for those "Model makers with long acquired skills and knowledge and computer operators with fancy machines".

Frankly, his remark is insulting to those of us who are CNC-capable, and I write to inform and educate those with similar thinking on how CNC machines actually work. Mr Drake's comments suggest that an operator simply plugs a drawing into a machine, and the machine does the work for you, with no skill required.

After spending 16 years in Subcontract Engineering working on both manual and

CNC machines, capable of machining parts up to four metres in diameter and weighing up to 10 tons, I can say that his thought process is so far from the truth.

There is not a single subtractive machining facility in the world that can operate in such a fashion. Before anyone can learn how to program a CNC machine, they first need to learn how tools work, how different materials behave, how to alter speeds and feeds to change cutting conditions, how to change speeds and feeds for different materials, how to calculate those speeds and feeds in the first place.

On top of this, much like driving steam engines, each CNC machine has its own set

of behaviours that the operator needs to understand to make the machines perform. Without mastering these skills first, you will never know how to get the best out of a CNC machine. Furthermore, operators need to learn 2D (if not full 3D) CAD in order to program all but the simplest of jobs.

From this, it is fair to say that the CNC machinist is more capable and qualified than the man who can only turn handles.

Edward J Parrott

The Editor replies: Edward makes a very valid point – newer engineering skills such as CNC may make processes easier in the long run but still need a lot of skill to use.

REVIEWS

'Stella' – a hot-air engine powered locomotive for 45mm gauge railways

Camden Miniature Steam Services is renowned for its model engineering books that are as fascinating as they are specialist and this certainly fits the brief. Probably the first book on such a subject, this describes in detail a loco that has been built in model form but never in full-size.

Stirling cycle or hot-air engines have never been able to produce enough power to adequately propel a locomotive but when Peter Scott

set out to produce such a locomotive in model form, fuelled by a small methylated spirit burner, the result proved rather more powerful than expected, able to haul half a brick on a flat wagon.

Using this book anyone can

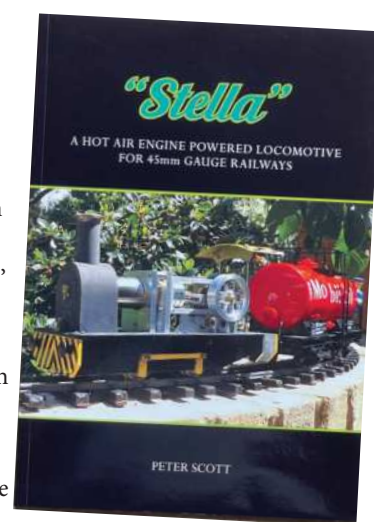
build their own version of Peter's engine – the process is described in detail, with full-size and very well-reproduced working drawings, and excellent photos that are again reproduced to a size that makes them truly informative.

One particularly welcome touch – scattered through the A4-sized softback are pages of graph paper which are there to give the builder somewhere to write those inevitable vital notes.

Adam at Camden describes the building of Stella as a project for the "more advanced beginner" and will soon be offering laser-cut parts to assist builders. Any **EIM** reader looking for an interesting and different project should get a copy of this inexpensive book. **AC**

ISBN 9781 90935 854 6 Price £18.95 plus £3.03 UK post.

Published by Camden Miniature Steam Services, email info@camdenmin.co.uk Web: www.camdenmin.co.uk



Castle Class 4-6-0 Locomotives – the final years 1960-1965

By David Maidment

Latest in the Pen & Sword-published and growing locomotive library produced by David Maidment focused on the final years of the Great Western Railway's renowned Castle class of 4-6-0 locomotives, and again takes an in-depth look at these engines.

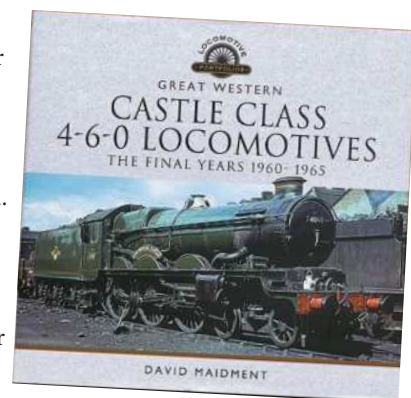
As in the several previous editions in the 'locomotive portfolios' series that we have reviewed in past issues, the book is very extensively researched, starting with a recap of the early history of

the class before describing their work in the service of British Railways, their performance analysed through a number of charts of individual journeys with times and speeds included.

A number of personal recollections are included from those who worked on the engines, and while there are no drawings to aid the modeller included in this particular book, there are a great many very informative period photos throughout, all reproduced to very good quality and a good size, and including a colour section running to more than 50 pages. **AC**

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Harrogate show reveals traders and club stands

The Harrogate Model Engineering Exhibition is set to go ahead on 10th-11th March, with organisers releasing a listing of booked exhibiting clubs and traders in recent weeks.

More than 40 confirmed displays include in excess of 20 model engineering societies and a clutch of model marine clubs, while promised attractions include a display of large-scale locomotives and a model boating pool – the opportunity to see marine modellers operating their craft is not something we've enjoyed at a show for a good while.

More than 25 traders are also listed as attending at the time of going to press, with many of the hobby's major names confirming their attendance at the event.

As reported last month the show will be based at the Great Yorkshire Showground in Harrogate and will be a combined event alongside the long-established Harrogate Model Rail model railway exhibition.

Ticket prices on the gate will be £15 adults, £1 accompanied under 16s, with tickets offering access to both shows. Discounted early ticket booking is on offer on the show website, www.theeventsoffice.com, with more details of the attractions being added as they become available.

Guide available to Garden show

Meridienne Events, organiser of the Annual Midlands Garden Rail Show which is sponsored by EIM and its sister magazine *GardenRail*, has published a downloadable guide to this year's event on 11th-12th March.

The show, which focuses on the smaller garden scales of Gauge O, 1 and 16mm, will be held in its usual venue of the Warwickshire Exhibition Centre. While the dates clash with the Harrogate show mentioned above, the Garden event is on the Saturday and Sunday, Harrogate on Friday and Saturday, making both shows 'doable' for the more enterprising visitor.

The Midlands show will feature all of the major suppliers to these scales, offering everything from components to complete locomotives, rolling stock, track systems and structures.

Locos will be in action on 11 layouts of varied styles while a quartet of model engineering societies will also be displaying at the event.

The show guide can be downloaded from the website at www.midlandsgardenrailshow.co.uk, the site also offering advanced ticket booking facilities. Reports on both the Harrogate and Midlands events will be in future editions of EIM.



Statfold goes 12¼-inch gauge

The roster of 12¼-inch gauge railways in the UK will increase by one later this year when the Mease Valley Light Railway opens at the Statfold Narrow Gauge Trust, near Tamworth in Staffordshire.

Trust spokesman James Gorton has provided us with more details of the line, construction of which started in 2021 and which when complete will add a whole new element to the extensive narrow gauge collection, already considered a must-visit site by many enthusiasts.

Construction of the locomotive shed and turntable was carried out first to provide a home for the acquired stock, with track being laid up to the field boundary.

The railway, which is being laid in S10 rail with new hardwood sleepers, will form an initial 1km-long line with a passing loop approximately halfway and run-round facilities provided at the far end. "It will help to close the site together with stations provided at the recently restored Duck Decoy, at the side of the lake and also at the far end of the line," James said.

Much of the stock has been acquired from the Windmill Farm Railway and currently two locomotives are on site. The steam loco is a 2-4-2 built in 2007 by the Exmoor Steam Railway, named 'Victoria' and originally intended to run at the planned Tintern Steam Railway, a project that never came to fruition.

The diesel locomotive is an 0-6-0 built by Alan Keef Ltd of Ross-on-Wye in 2005, originally for a private railway in Devon.

Passenger rolling stock comprises a trio

of carriages built for the 15-inch gauge line that ran around the Liverpool Garden Festival in 1984, a pair of closed vehicles built by the Exmoor Steam Railway together with an open version for carrying pushchairs and such like, and two Uerdingen Coaches originally built for the 1937 'People at Work' exhibition in Dusseldorf, Germany. One of the Liverpool vehicles is being heavily converted to carry wheelchairs.

Freight rolling stock comprises a Bogie open wagon, bogie box wagon and bogie flat wagon all of which were built for the private railway in Devon.

This is obviously an exciting development both for Statfold and the other 12¼-inch gauge lines in the UK, including the Littlehampton Miniature Railway, Exbury Gardens Railway and the Fairbourne Miniature Railway on which EIM technical editor Harry Billmore works, his trails and tribulations as engineer featuring in our issues each month. We will bring readers more details of progress on the Statfold line as we get it, and meanwhile details of when the Trust is open can be found on the website at www.statfold.com

Model engineering suppliers

We want your latest news! New product, any newsthat will be of interest to our readers? Space is available on this page. Please send details, and pictures, to editor@engineeringinminiature.co.uk

October dates confirmed for MMEE

More positive show news, and a date for those pristine new diaries, or whatever the modern electronic versions of such are...

Meridienne Events, organiser of the EIM-sponsored Midlands Model Engineering Exhibition, have confirmed that following the successful post-pandemic return of the event last October, the 2023 edition will take place from Thursday 12th to Sunday 15th October

2023 at its usual venue of the Warwickshire Event Centre near Leamington Spa.

The exhibition website at www.midlandsmodeleengineering.co.uk will be updated throughout the year as more details become available, and will include advanced ticket booking facilities nearer the event.

We will of course also provide any updates in our pages.

Steaming into a new season

The 'closed season' doesn't seem to happen any more with several clubs in steam...

COMPILED BY ANDREW CHARMAN

The pace is quickening again as we start our latest round-up of the goings on around the various tracks and clubs of the UK – I may be penning these words at the end of January, one month of the year when most of us stay indoors, but already our diary listing is growing again as clubs prepare for their public-running dates throughout 2023 – and yes, I fully appreciate a growing number of hardy clubs keep running right through the depths of winter!

One club that is no doubt looking forward particularly to the new season is the **Melton Mowbray & District ME** – the club's Norman Smedley tells us that since before the pandemic some members have been very busy extending the ground-level track at the club's Whissendine Sports Club site. "We are now able to enjoy running on the track and on Sunday 30th April – 30 years after the first track on our site – our President Jennifer Lady Gretton will officially open the new track," Norman says.

Lady Gretton is of course the widow of John, the third Baron Gretton, whose father built one of the most renowned small-gauge lines in the UK, the Stapleford Miniature Railway at Stapleford Park. This line is still running today, we're glad to say, holding occasional open days with details at <https://fsmr.co.uk>.

Melton Mowbray is certainly a thriving club, not only with raised and ground-level lines of 3½, 5 and 7¼-inch gauges but with a clearly very active membership, demonstrated by the club winning the best stand at the Midlands Model Engineering Exhibition back in October last year.

Tell us more

Which reminds us – the depth of activity and enjoyment available in our model engineering clubs often goes unappreciated in the wider world, and last year we set out to rectify this with a new *My Club* feature, written by members about their club or society. We published interesting pieces on the Sussex Miniature Locomotive Society and Hereford ME, but nothing since.

So come on club members! Space is waiting for you to tell **EIM** readers about your organisation. Put down in words a bit of history, what your club offers and why it is special, add in some pictures showing members in action, and we'll happily give you



THIS PAGE:

Two pictures kindly supplied by Norman Smedley of the Melton Mowbray & District ME of the club's recently completed ground-level extension, which will be officially opened in April.

Above, member Rosie Woolston is driving 'Hercules' on the Out Running Road of the extended line, clearly on a festive service! At right Dave Oliver and Chris Woolston are enjoying running on the extended line in the latter part of last year – sadly Dave passed away in November, a major shock to Society members.

some publicity – plus a boost to club funds (or the writer's...)

We always like additions to the club and society journals received at **EIM** Towers, and we don't think we've seen *From the Smoke Stack* of the **Gravesend Model Marine and Engineering Society** before.

A quick glance at the website (www.gmmes.co.uk) describes this as a "small friendly club", its North Kent track overlooking the Thames Estuary – as the name suggests the club's origins lay in a marine modelling club, the Thames Group Marine Society formed in 1953 (usual **EIM** reminder, we don't get enough marine modelling sent in to use in our pages, hint, hint...).

Today the club's activities centre on a raised track of 371 metres in length offering 3½ and 5-inch gauges. Writing in the newsletter club chairman Richard Lightle reports a successful 2022 season, especially the Santa Specials, Richard adding his thanks to all the members who turned out to assist with these despite a day of freezing fog across the track site.

Richard also adds that the forthcoming club evening meeting programme includes in April what he describes as his favourite meeting of the year, Project Night. "I love to see what members have been working on in their workshops, whether it be tooling, boat building or complete





miniature steam engines – we are not all at the same level of competency but we can all learn from one and other and share ideas on how the end goal is achieved,” he says, and we could not put that better ourselves...

Pressure vessels

In October the Gravesend club hosted the boiler seminar jointly run by the Northern Association and Federation of Model Engineers, a full and involved day on this most essential of subjects. A paragraph in the report by the club’s boiler tester certainly resonated, stating; “The hobby is very lucky in so much as we have the privilege of checking our own boilers that otherwise if a commercial tester were brought in, would cost a great

deal of money taking the hobby out of reach for the vast majority.

“We must therefore make it our duty to follow as close as possible the guidelines laid out in the Boiler Test codes in order to maintain this privilege.” Wise words indeed...

Similar comments to Gravesend in the latest edition of the **Bradford ME** newsletter, club president Jim Jennings reflecting on the recent ‘Bits & Pieces’ evening meeting. “It is always interesting to find out about the knowledge and expertise of our members in different areas of our hobby, and I think we can all learn something from these evenings,” Jim muses, with good reason.

Elsewhere in the newsletter there is a report on said evening, at which



ABOVE: Now that’s an impressive bit of kit... Bradford member Godfrey Wormald has no intention of getting his hands wet when launching his boats... *Photo: Bradford ME*

LEFT: Efforts to keep the editor’s grandson happy saw his dad proving that their is miniature steam to be enjoyed in the winter with a trip on 28th January to the 10¼-inch gauge Eastleigh Lakeside Railway. The headboard on 1937-built 4-4-2 ‘Ernest Henry Upton’ will amuse all ages, while we understand the return to service of the 1964-built A4 Pacific ‘Sir Nigel Gresley’ has encountered the odd technical hiccup... *Photos: James Charman*

the varied items shown by members included a model boat built for racing by Derek Round, who discovered on trying to minimise the electrical losses in the drivetrain that the motor gave more power in reverse than in forwards. He thus made a dynamometer to test the motor and found that the timing of the commutator was critical to maintaining the motor’s power. The question was, does altering the timing contravene the rules?

Other members showed the huge benefits of such evenings, from Martin Birch describing how he solved the problem of making bogies for a Laxey Coast electric tram, on discovering that the curve on the top of said bogie was larger than could be accommodated by his milling machine. The solution was to build a large fixture to do the job – sounds like something **EIM** readers would be interested in Martin...

Other items on the night included a 1:1 Vincent motorcycle engine, a host of small tools, some of which were specially made, and a nice model of a Matthew Murray hypocycloidal engine – clearly an evening that was as informative as it was enjoyable!

Kind to the knees

Also spotted in the newsletter is a rather neat hoist built by member Godfrey Wormald to launch boats into the club’s boating lake, due to “many of our members’ boats growing in size and, more importantly, weight at the same time as our members are declining in stature and strength...” A sensible solution...

We reported last month how it’s a time of great change for Polly Model Engineering as the supplier known for its model locomotive kits moves into new ownership. Meanwhile the **Polly** ►





Owners Group is going from strength to strength, and secretary Neil Mortimer has been in touch with details of the club rallies for 2023. These will take place on 13th May at the **Andover & District ME**, this meeting including the Polly Owners Group AGM at 10am, and on 9th September at the **Rugby ME**.

New surroundings

The visit to the Andover track is likely to be particularly interesting as the club does not hold public running days. The track runs through the woodland of Upping Copse, near the village of Wherwell, and was once a

military munitions depot, one of the Nissen huts having been repurposed as the society club house. The raised line is of 415 metres in length and caters for 2½, 3½ and 5-inch gauges, while there is also a 1.35-mile long ground-level line for 5-inch and 7¼-inch gauge and a raised 32/45mm garden railway.

The action starts around 10am on both days and anyone requiring further information on either event is welcome to contact Neil on 07900 133201 or neilmortimer@gmail.com.

Club publications are always the source of much useful information and the Polly newsletter is no



"Your editor when he rode the biscuit felt that he almost had to lean out on the bends sidecar style..."

ABOVE LEFT & LEFT:

Rallies run by the Polly Owners' Group always enjoy a good turn-out and clearly are a lot of fun – the club has now announced the dates of its 2023 gatherings. Photo: POG

ABOVE RIGHT:

This scene on the front of the Welling newsletter gives no clue that the club is still getting used to its very new surroundings.

RIGHT: The 12¼-inch gauge Evesham Vale Light Railway is on the search for a new owner. Photo: Jonathan James

Welling & District Model Engineering Society

Founded in 1945



Magazine No 201
February – March 2023



Ready for the off at the Boxing Day run

Photo: Peter Cook

1

different, the most recent edition including a neat little way of easily securing grates and ashpan back into locomotives contributed by member Richard Taylor – they are so handy, such little dodges...

The rapid progress made by the **Welling & District ME** at its new site, reported in previous editions of these pages, is obvious from the delightful picture on the front of its latest newsletter which shows an impressive line-up of model locomotives on the steaming bays.

Inside we learn that alongside "much drinking of tea" over the past two months great progress has been made with fitting out the interior of the new clubhouse, and it's clearly suitable for its intended purpose as the newsletter informs members of a schedule of weekly evening meetings on a nicely varied range of subjects.

The club staged "hopefully the first of many" Boxing Day runs at the new track and clearly much fun was had by all. The weather was reported as unseasonably warm and sunny, "until just after lunch when it reverted with a vengeance..."

Fishy subject

You also have to admire the word skills of some magazine correspondents... Welling member Bob Underwood contributes a most interesting piece to the latest newsletter on atmospheric railways from Brunel to modern times, but starts it with a comment on the cost of research to discover whether goldfish have a better memory than has long been thought...

The cover of the *Goodwin Park News*, newsletter of **Plymouth Miniature Steam**, illustrates a subject that is no doubt occupying many a club member across the UK at least, track maintenance, with a new point going into the club's ground-level line. Apparently this section is just outside

the station and has been carried out in addition to much longer lengths also being renewed over the winter.

Rapid progress also appears to be being made with the refurbishment of the Plymouth club's new and second Kerr Stuart Wren locomotive, one member having almost completed the cylinders, putting the onus on chairman Ian Jefferson to have the frames ready to accept them! Joint projects involving several club members can be so rewarding, as well as of course moving projects along rather more quickly than if someone was working on their own.

Art in metal

On the subject of cylinders, the Plymouth newsletter also includes an extensive report on a visit made to the annual convention for members of the A1 Locomotive Trust – pictured is the cylinder block for the Trust's P2, its second locomotive new-build after the celebrity A1 class 'Tornado'. What an impressive bit of metal the cylinder block is!

Your editor smiled as he saw a picture in the latest **Lincoln ME** newsletter of member Ben Clarke's 7¼-inch gauge model of the Ffestiniog Railway's former Penrhyn Hunslet locomotive 'Linda' – the model is close to completion and almost ready to steam for the first time. Why a smile? In my other role as editor of *Narrow Gauge World* magazine I recently received a review sample of Bachmann UK's 009 model of Linda, that's 4mm to the foot scale. It's a superbly detailed model, and one that would fit down the chimney of Ben's...

Just as I sign off these pages an email drops in the box from the **7¼" Gauge Society** – if you have the dates for the 2023 Annual Meeting and Gathering in your diary, then you need to change them! Due to unforeseen circumstances the event, at the Mizens Railway near Woking in Surrey, will take place a week earlier

than previously announced, on 15th-17th September.

As we rapidly run out of space a reminder that many clubs will be exhibiting at the two shows that are happening in March – the revived Harrogate Model Engineering Exhibition is at the Great Yorkshire Showground on 10th-11th March, and the Midlands Garden Rail Show at the Warwickshire Event Centre on 11th-12th March! Full details are in this month's general news round-up on page 39.

Line for sale

And finally, fancy owning your own miniature railway? As we go to press news reaches us that the 15-inch gauge Evesham Vale Light Railway, in Worcestershire, is up for sale.

Built in 2002 and owned since 2012 by the Adrian Corke and his wife Sandra, the line is located in a country park, alongside a retail centre that has 22 shops and three restaurants providing a steady stream of travellers for the line – it carries around 48,000 passengers a year and produces an annual turnover of around £175,000.

It's a great line to drive, as your editor can personally testify, and included in the sale are one resident steam and a diesel locomotive and three semi-open carriages.

Mind you, what the press release announcing the sale does not report is whether the sale includes 'The Biscuit'. This is basically a box on rail wheels, within which is hidden a JAP motorcycle engine. You sit on top of it and hang on for dear life as you are taken round the track at quite a speed – your editor when he rode it felt he almost had to lean out on the bends sidecar style, and son Stewart returned from a ride round the Evesham circuit with a huge smile on his face...

The line comes with a 10-year minimum lease from the park owners, and could be yours for £325,000, which to me sounds a bargain.



ABOVE: New

steam – this 15-inch gauge loco is being built by North Bay Railway Engineering in Darlington for the Perrygrove Railway in the Forest of Dean. Photo: NBRE

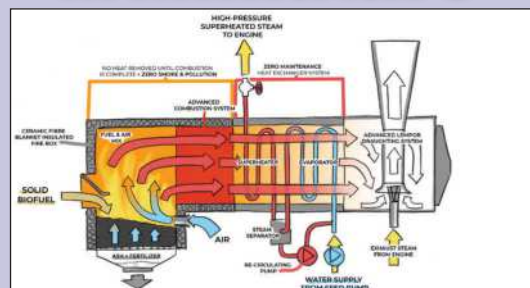
RIGHT: Fun on a box – Stewart Charman takes a ride in 2014 on the Evesham line's 'Biscuit'...

Serious enquiries only can be made to Adrian on enquiries@evlr.co.uk – so, how tempted are you?... **EIM**



Coming next month in...

THE MAGAZINE FOR MODEL ENGINEERS ENGINEERING in Miniature



- Future steam? Radical boiler concept
- Tipper trucks for ride-on railways
- Ways to bend metal
- Gauge 1 kit building
- ...and much more!

April issue on sale 16th March

Contents correct at time of going to press but subject to change

DIARY

EVERY SUNDAY

North Wilts ME public running, Coate Water Country Park, Swindon SN3 6AA, 11am-5pm

Rochdale SMEE public running, Springfield Park, Bolton Rd (A58), Rochdale, pm.

FROM 28th March - Gravesend MM&E public running, Cascades Leisure Centre, Thong Lane, Gravesend, Kent DA12 4LG, 1-4pm

MARCH

- 1** 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

- 3** Welling & District ME meeting, Bits & Pieces, Hall Place Gardens, Bourne Road, Bexley, DA5 1PQ

- 4** Rochdale SME general meeting, Castleton Community Centre, Manchester Road, Rochdale, 7pm

- 4** SMEE General Meeting, Marshall House, 28 Wanless Rd, London SE24 0HW, 2.30pm

- 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** Welling & District ME meeting, Bring & Buy, Hall Place Gardens, Bourne Road, Bexley, DA5 1PQ

- 10** Harrogate Model Engineering Show 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, Warwickshire Exhibition Centre, 10am-4pm each day. More details at www.midlandsgardenrailshow.co.uk

- 13** Melton Mowbray & Dist ME Annual General Meeting, Melton Road, Whissendine, nr Oakham, Rutland LE15 7EU, 7.30pm

- 14** Romney Marsh ME Members' Social A'noon, Rolfe In, 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

- 17** Rochdale SMEE meeting, informal exhibition night, Castleton Community Centre, Manchester Road, Rochdale, 7pm

- 17** Welling & District ME meeting, Chat night, Hall Place Gardens, Bourne Road, Bexley, DA5 1PQ

- 18** SMEE Engine Builders Group, Marshall House, 28 Wanless Rd, London SE24 0HW, 2pm

- 18** Sydney LSLS running, Anthony Rd, West Ryde, NSW, Australia

- 19** Melton Mowbray & Dist ME members steam-up, Sports Club, Melton Road, Whissendine, nr Oakham, Rutland LE15 7EU, 7.30pm

- 21** Romney Marsh ME meeting, products of the winter workshop, Rolfe Lane, New Romney, 7.30pm

- 24** Welling & District ME meeting, Stationary & IC engine night, Hall Place Gardens, Bourne Road, Bexley, DA5 1PQ

- 25** Federation of Model Engineering Societies Annual General Meeting, National Coal Mining Museum, Overton, Wakefield, West Yorks, 12.30pm

- 25** Gravesend MM&E meeting, talk on old cars, Cascades Leisure Centre, Thong Lane, Gravesend, Kent DA12 4LG, 8pm

- 25** Romney Marsh ME boiler testing Rolfe In, New Romney, 9am-noon, running from noon

- 25** Teeside SMG Members steam-up, Preston Hall Museum, nr Stockton, <http://tsgr.co.uk>

- 25** Eastleigh Lakeside Railway Diesel Gala, Lakeside Country Park, Eastleigh, SO50 5PE www.steamtrain.co.uk

- 25** Ryedale SME GL5 Society Rally,

- 26** Pottergate, Gilling East, North Yorkshire YO62 4JJ

- 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** High Wycombe ME Sunday Morning members Steam-up, Watchet Lane, Holmer Green HP15 6UF

- 26** Romney Marsh ME track meeting, Rolfe In, New Romney, Kent, from noon

- 30** Southampton SME AGM, Bitterne Social Club, Southampton, 7pm

- 31** Welling & District ME meeting, 3D Printer night, Hall Place Gardens, Bourne Road, Bexley, DA5 1PQ

APRIL

- 1** Bradford ME Annual Exhibition & Competition, Saltaire Methodist Church, 12.30pm-4pm

- 1** SMEE Annual General Meeting, Marshall House, 28 Wanless Rd, London SE24 0HW, 2.30pm

- 2** Guildford ME Small Model Steam Engine Group open meeting, Stoke Park Railway, London Rd, Guildford, Surrey GU1 1TU, 2-5pm. www.gmes.org.uk

- 2** Plymouth MS public running, Goodwin Pk, Plymouth, PL6 6RE 2-4.30pm

- 5** Bradford ME Meeting, boating theme, Saltaire Methodist Church, 7.30pm

- 5** Bristol ME meeting, The Gresley P2 Locomotive Project, Begbrook Social Club, BS16 1HY, 7pm for 7.30pm— secretary@bristolmodelengineers.co.uk

- 5** Lincoln ME Annual General Meeting, The Stone Arms, High St, Skellingthorpe LN6 5TS, 7.30pm

- 7** Rochdale SMEE meeting, Just Nattering in the Hut, Springfield Park, Bolton Rd (A58), Rochdale, 7pm

- 8** Bradford ME Easter Bunny public running, Northcliff Railway, Shipley, BD18 3DD, 12.30pm-3pm

- 9** Ryedale SME public running, Pottergate, Gilling East, North Yorkshire YO62 4JJ

- 9** Bristol ME public running, Ashton Court Railway, BS8 3PX, noon to 5pm

- 10** Melton Mowbray & Dist ME meeting, talk by Peter Hayward, Sports Club, Melton Road, Whissendine, nr Oakham, Rutland LE15 7EU, 7.30pm

- 10** North Wilts ME public running, Coate Water Country Park, Swindon SN3 6AA, 11am-5pm

- 13** Guildford ME public running, Stoke Park Railway, London Rd, Guildford, Surrey GU1 1TU, 10am-1pm

- 16** Melton Mowbray & Dist ME members steam-up, Sports Club, Melton Road, Whissendine, nr Oakham, Rutland LE15 7EU

- 21** Rochdale SMEE meeting, The Big Ditch by Judith Atkinson, Castleton Community Centre, Manchester Road, Rochdale, 7pm

- 22** Gravesend MM&E meeting, project night, Cascades Leisure Centre, Thong Lane, Gravesend, Kent DA12 4LG, 8pm

- 22** SMEE Engine Builders Group, Marshall House, 28 Wanless Rd, London SE24 0HW, 2pm

- 22** Teeside SMG Members steam-up, Preston Hall Museum, nr Stockton, <http://tsgr.co.uk>

- 23** Guildford ME public running, Stoke Park Railway, London Rd, Guildford, Surrey GU1 1TU, 2-5pm

- 23** Ryedale SME public running, Pottergate, Gilling East, North Yorkshire YO62 4JJ

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.



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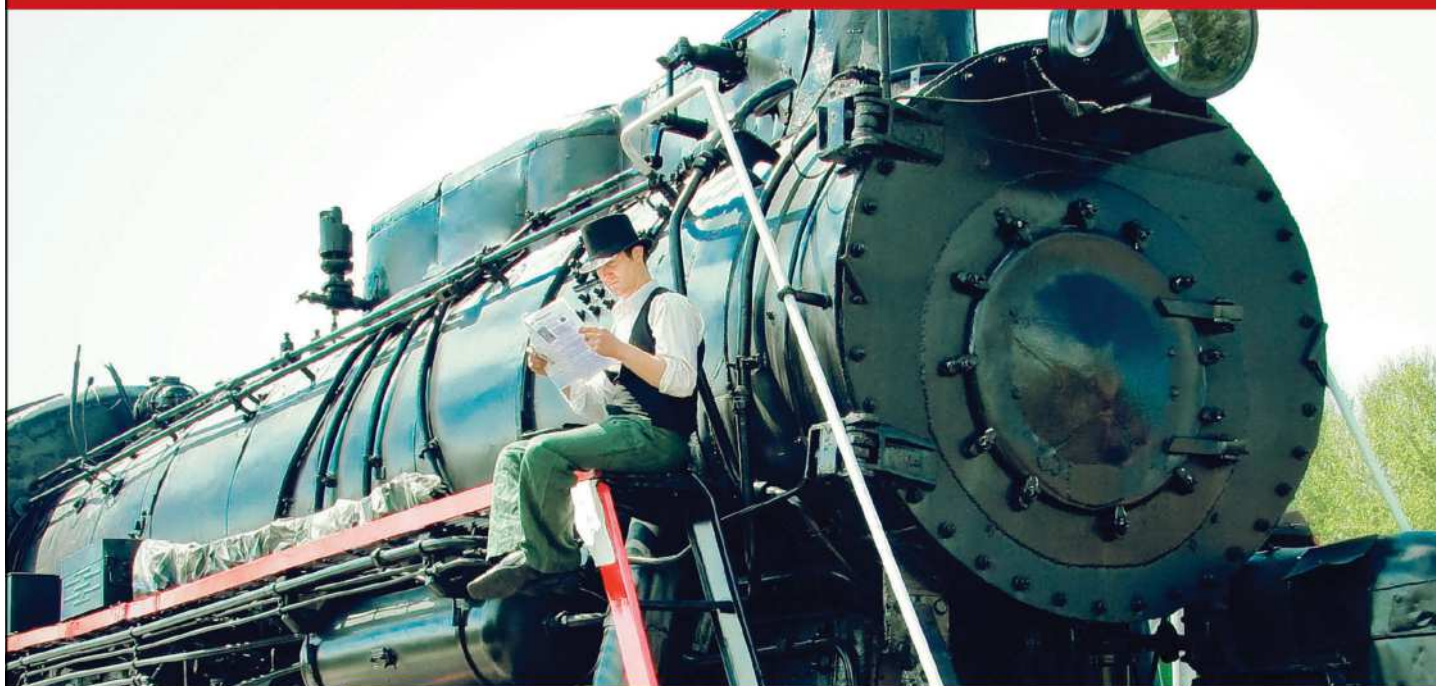
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BARRETT STEAM MODELS	46	PAUL NORMAN PLASTICS	48
COLLEGE ENGINEERING SUPPLY	47	SILVER CREST MODELS	5
HOME AND WORKSHOP MACHINERY	52	STATION ROAD STEAM	51
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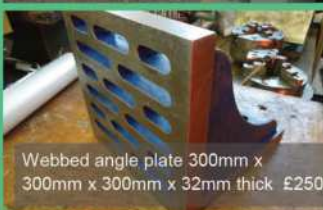
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