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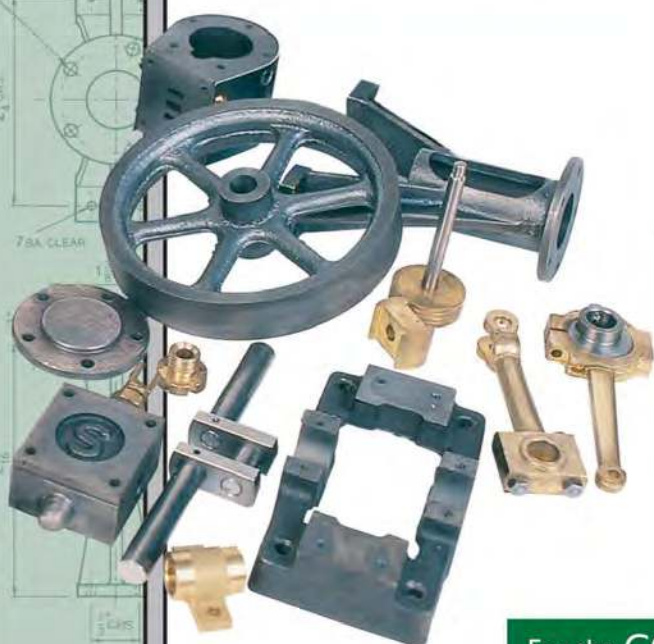
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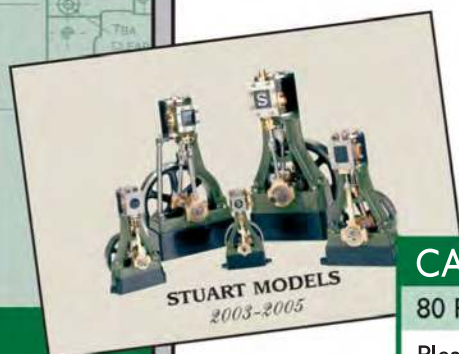
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FRONT COVER

Who says that dioramas are just for the smaller 'scenic' scales? This little 5-inch gauge cameo was part of the impressive Maidstone stand at the London show in January. Our report begins on page 27.
Photo: Andrew Charman



EDITORIAL

Small can be just as beautiful...

Welcome to **EIM**. at the conclusion of another busy month for the team. I must admit to being quite pleased with the variety in our pages this month which includes milestones for two of our major build projects.

Andrew Strongitharm's Barclay 0-4-0 tank 'Dougal' reaches a stage which in any project provides major encouragement to keep on going, when he connects his chassis up to a pump for the first time and watches the motion finally moving, powered by compressed air. It's always a special moment when one sees all the bits one had slaved over making, all working together for the first time.

Andrew also takes the chance to trail-fit the boiler in position, giving him a real sense of how his finished loco will look. As we know it looks very well, Dougal's latest starring role being at the London show in January where many visitors recognised it from these pages and kept Andrew busy with questions! Of course we have a full show report in this issue.

Meanwhile Martin Gearing reaches a significant point in the build of the **EIM** Steam Plant boiler, beginning to solder all the components together. Any novice engineer nervous at the prospect of silver soldering will find much to inform and encourage in Martin's words.

Tech Ed Harry, meanwhile, has been learning about ways of building large-scale road loco wheels, as a result of helping a colleague to move workshop. And Martin Johnson's innovative Fowler build project makes clever use of yet more full-size car components.

One feature not in these pages is 'Detailing a Decapod', promised last month. Did anyone spot the deliberate error? Yup, we ran that feature back in November 2017! The Ed's not very acceptable excuse was that it was before he assumed the hot seat... At least we spotted the error before we repeated the feature - doh!

Smaller models also make an appearance with Jonathan Palterman advocating two new scales which would provide enough size to do some proper model engineering, without taking up the space the traditional scales do. I know some traditionalists decry the smaller scales but they really shouldn't – the first model-related magazine I edited was that of the 16mm Association and during my time there I saw some superb home-built locos that were without doubt proper engineering in miniature – just a little more miniature! Enjoy your **EIM**...

Andrew Charman – Editor

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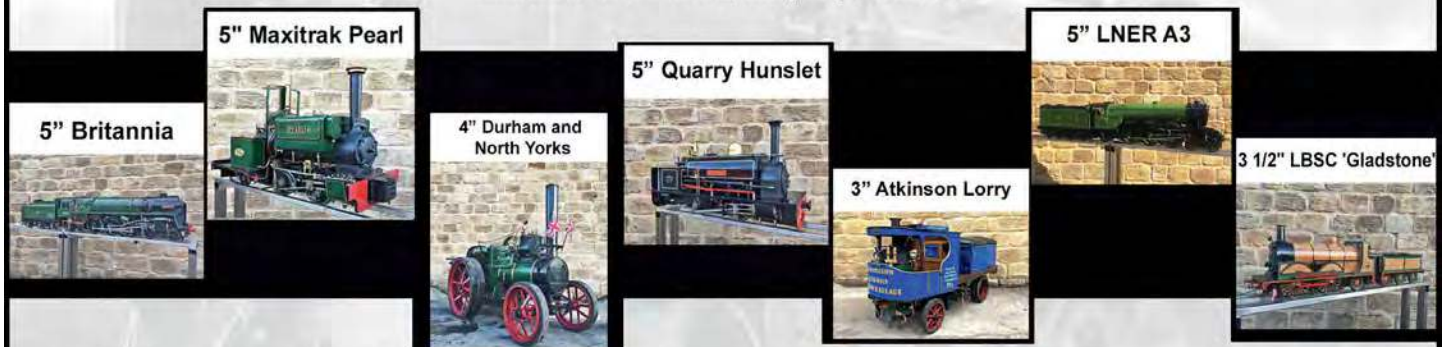
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Wheel building at Ashley's

Harry describes a novel method of making the wheels for a 6-inch Fowler crane engine.

BY HARRY BILLMORE

I first met Ashley Tempest when I started working at Station Road Steam – he is the firm's general manager and boilermith, as well as being responsible for most of the overhaul work undertaken there. His knowledge of road locomotives and in particular Fowler road locomotives is expansive and really quite impressive, so when he asked me to help him move workshops, it came as no surprise to find a 6-inch scale Fowler B6 crane engine sat somewhat forlorn in the corner, and under a bench, and stashed behind the lathe...

The reason for the workshop move is entirely to finish this huge project – going from a workshop a half hour's drive away to one that is a five-second walk down the garden has a lot of advantages. There are a few drawbacks however, such as the gap down the side of the house will only be just wide enough to get the engine out of the back garden when it is complete, and then only without the hubcaps on.

This first time I saw the engine, there was a largely complete front end, wheels, axle, perch bracket, smokebox, chimney and cap sat assembled on a stand, with the rear wheel outers rolled awaiting fitting of the T-rings and making of the centres.

It is Ashley's method of wheel building which is the subject of this article. Having built engines and trailers for other people in a variety of scales, he had a fair idea of where to start, however in his drive to create the most authentic half-sized B6, he did not want to go down the normal route of bolting the spokes into the hub and then covering them with the outer half of the wheel centre. Instead



ABOVE: A complete front wheel for the 6-inch Fowler crane loco.

PHOTO 1-2: Machining the front wheel hubs from bar.

Photos in this feature by Ashley Tempest and Megan Charman

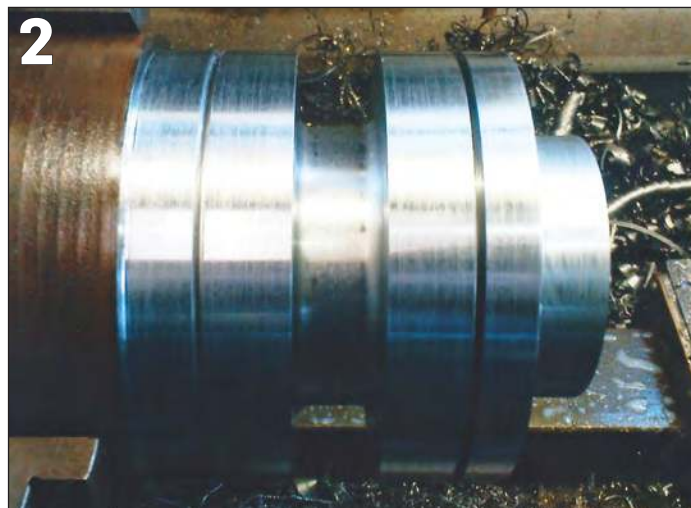
he went with a welded approach to as nearly replicate the cast-in spokes of the original engines.

The front wheels were relatively simple things to do this way. Each hub was split into three sections where the spokes enter the hub and turned on the lathe from a solid bar (**Photo 1**). Once the turning operation was finished (**Photo 2**), the machined parts were shot blasted to give them a finish similar to a casting. The centre section of each hub was then mounted on the mill and slots machined into it to accept the spokes (**Photo 3, 4**). These were laser cut and then bent to the correct shape.

The wheel rim with the T-ring already welded in was then set up on a bench, with the hub then set up central and true with the rim. Each spoke was clamped to the T-ring in its correct place with the other end resting in the slots machined in the hub centre, and the spoke welded into the hub (**Photo 5**).

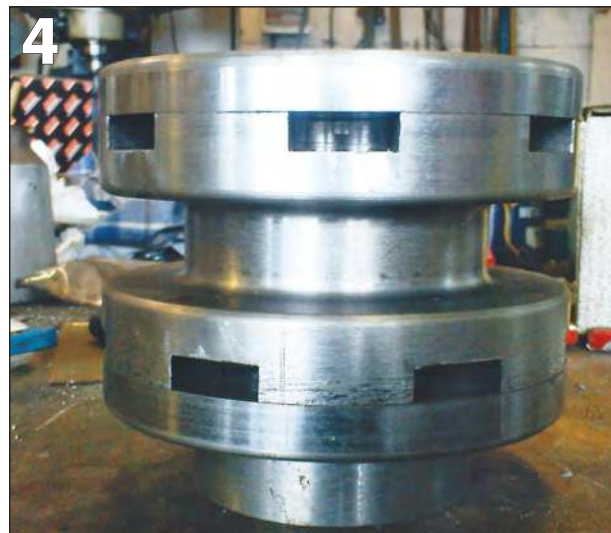
After this operation the spokes and T-ring were drilled and then bolted together, before the assembly was turned and the operation repeated for the spokes on the other side.

Once all the spokes were bolted in, all of the rivet holes were then drilled (**Photo 6**) before the rivets



**PHOTO 3:**

Machining slots for spokes in hub.

**PHOTO 4:**

Completed hub with slots for spokes.

**PHOTO 5:**

Laying spokes in place.

PHOTO 6:

Drilling holes in the wheel rim using spokes as guides.

PHOTO 7:

Operation underway to rivet spokes to rim.

hub (Photo 11, 12) to allow each half to be withdrawn from its sand mould before the two halves of the mould are combined and the molten steel poured in to produce the castings (Photo 13).

Once the castings were back from the foundry, the basic assembly steps were the same as for the front wheels, although with the larger rears it is

easier to press the bronze bearing material into the hubs before fitting the spokes and rims.

The machining work was done on the mill (Photo 14), with several passes of a face cutter to get the initial register face flat and true, before turning over, boring the bearing hole to size and face cutting that side. The ►

were hot pressed into place (Photo 7) with a tool made by Ashley, more on this tool later!

Rear wheel challenges

The rear wheels were much more complicated to make. For a start the hubs are not round and their design sees different-length spokes radiating out to different parts of the wheel. Also the available castings are in cast iron, which is not conducive to welding steel spokes to.

The solution Ashley came up with was to produce his own patterns and then cast the hubs in steel, which while slightly more expensive than iron, does mean that they then can be readily welded to the spokes.

Ashley took advice from a friend before making the patterns. He referred to the original drawings (Photo 8), added the correct shrinkage allowance for steel, and then made the patterns in sections from a combination of MDF, wood offcuts and copious amounts of filler (Photo 9, 10).

Much of the filler was used to create the draft angle to allow the pattern to be removed from the sand. Also for this reason the pattern is split lengthways down the long axis of the



8



9



10



11



12

**PHOTO 8:**

Casting pattern required study of drawings.

PHOTO 9-12:

Patterns made in wood.

PHOTO 11:

Rear hub patterns split down middle.

PHOTO 13:

Blank castings.

PHOTO 14:

Machining done on mill.

spoke slots are then machined into each side as before using a dividing table, and the bearing added (**Photo 15**). The other steps are then followed (**Photos 16-18**) to end up with a completed wheel.

Riveting stuff

The rivet press that Ashley made for this job will be of interest to many of our readers, as well as the problems he had in using it. The main frame is laser-cut 1-inch plate, with large cut-outs to go between the spokes. As can be seen in photo 12, there is another side plate which was intended to go on the other side of the hydraulic cylinder, but Ashley experienced problems feeding it inbetween the

13



14





spokes and getting the head to line up with the dolly correctly. So he decided that only one side was needed and given there is no significant bending, that decision was shown to be correct.

Readers will also note a large weld running across the side plate not too far from the dolly – this was to reposition everything after it was discovered there was not enough travel on the cylinder to press a rivet home fully in one go.

Note too that the side plate is not completely flat, this is to provide the maximum support for the dolly in line with the cylinder. **EIM**

■ We hope to carry further progress reports in future issues as Ashley's build continues.



PHOTO 15: Wheel bearing inserted in machined hub.

PHOTO 16: Setting the rear spokes.

PHOTO 17: Preparing for the welding.

PHOTO 18: Rear wheel with welding completed on one side.

PHOTO 19: Built-up rear wheel hub.

PHOTO 20-21: Details of rear wheel riveting.

PHOTO 22: Rivet press fabricated from laser-cut components then significantly modified in two planes.



Dougal – a 5-inch Barclay

Young Sussex engineer Andrew reaches a milestone on his entry-level locomotive construction project, seeing the motion running for the first time.

BY ANDREW STRONGITHARM – Part Eleven of a series

The final two tasks that still needed completing before attaching the air line for the first time were centralising the valves in the steam chest and setting the position of the eccentric stop collars (which govern the position of the valves in relation to the pistons). I spent most of the time adjusting the inside motion with the chassis turned upside down so that I could easily gain access to the steam chest but to prevent confusing anyone, the following description is based on the locomotive being the correct way up.

I knew that the inside of my steam chest was $1\frac{7}{8}$ -inch long and that each valve was $1\frac{1}{8}$ -inch long. The eccentrics produce a total travel of $\frac{5}{8}$ -inch and therefore combined with the valve length this gives a total of $1\frac{3}{4}$ -inch which leaves only a $\frac{1}{16}$ -inch at the end of each valve once they are installed within the steam chest. Centralising the valves means ensuring that they don't over travel and hit the end of the steam chest and that they admit and exhaust steam equally with each revolution of the wheels. My valves were made slightly differently to the drawings with a lock nut fitted to each end in addition to the valve length.

For this job it makes no difference where on the rear axle the eccentric stop collars are locked in place and I used feeler gauges to check the clearance against the wall of the steam chest at either end of the valves. As explained these gaps should be about $\frac{1}{16}$ -inch if everything has been built exactly to the drawings or in my case 10 thou

over the lock nuts! If necessary, the valve rods should be adjusted in the fork ends until both valves are running centrally within the steam chest. (Photo 1)

Next, the stop collars for the two eccentrics which drive the valves have to be set in the correct position on the rear axle so that the valves open and close the ports at precisely the right point on every revolution of the wheels. Starting with the left-hand (or leading) side of the locomotive, I rotated the wheels forwards to set the coupling rod so that it was just short of the full forward position. To explain I would recommend that the bottom edge of the coupling rod is in line with the centre of the axle. Care should be taken to ensure that the wheels don't move now as this would potentially affect the timing of the locomotive.

I then moved the left-hand stop collar round until it touched the drive pin of the eccentric and looked at the left-hand valve in the steam chest to check if the front steam inlet port was exposed. If not, gently tap the stop collar and eccentric forward until the port appears and you can fit a 4 thou feeler gauge into it. Once this is possible, tighten the locking bolt in the stop collar until it clamps firmly on the axle. If you happen to knock it forward too far simply turn the collar a full revolution and start again.

I now repeated this process with the right-hand side motion and with this complete I rotated the wheels backwards to check the front ports again but this time in reverse gear. Once the front ports have been completed in reverse gear, the same



The prototype 'Dougal' loco is a 2ft 6in gauge Barclay 0-4-0 built in 1946 for the Provan Gasworks in Glasgow and today resident on the Welshpool & Llanfair Light Railway in mid Wales.

process needs to be applied to the rear ports. In theory, and if the valves have been perfectly centred, the opening of the rear ports should match that of the front ones.

The ultimate test would be how the beats of exhaust steam (or air whilst testing) sound as all four should be evenly spaced with each rotation of the wheels. If, after setting, you are not able to obtain four even beats then do go back immediately and check the settings again, including whether one of the stop collars has inadvertently slipped on the axle during the set up process.

Preparing for running

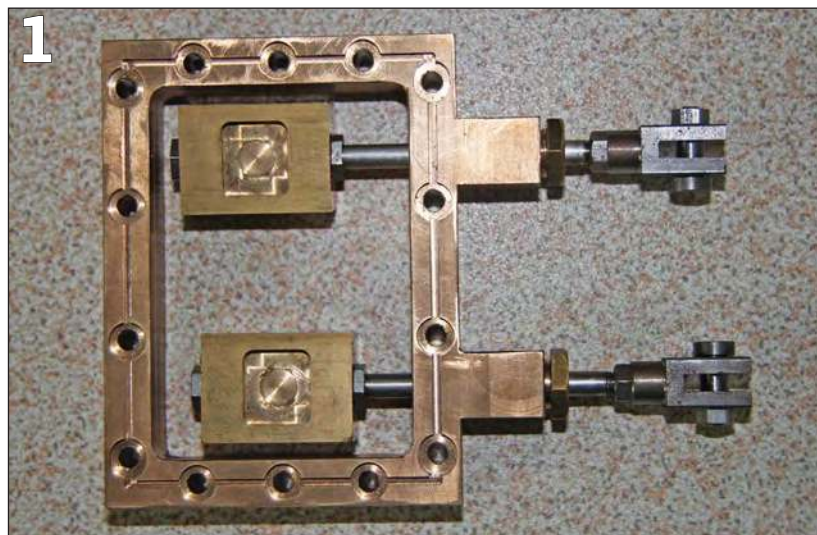
I cut up four small pieces of $\frac{1}{8}$ -inch steel plate to insert beneath each axle box in order to hold them up off the keeps roughly at their running height. The geometry of the valve gear is designed to work best with the full weight of the loco sitting down on the springs. I then raised the chassis slightly up off the bench by placing a couple of pieces of wood under the buffer beams to allow the wheels to be free to rotate.

I ensured that the locomotive was in forward gear by turning the wheels by hand at least one full turn in that direction and applied liberal amounts of lubricating oil to all the moving parts and faces before opening the air valve on the compressor to see what would happen.

The first problem to overcome was to investigate if everything was sealed and air tight. The easiest way to do this is with bubbles! A mixture of washing-up liquid and water works well if applied with a paint brush around all the parts where you would potentially expect air (or steam) to escape. As expected this showed that a couple of the piston and valve rod glands required tightening up but the

PHOTO 1: The steam chest assembly shown off the loco before adjusting the valve rods to ensure that the valves run centrally in the steam chest.

All photos in this feature by Andrew Strongitharm



steam chest and cylinder covers were all bottle tight.

At this point I noticed bubbles forming on the outside face of one of the cylinders. Upon further investigation it transpired that the whole casting was ever so slightly porous. To this day I can't explain the cause or give a full explanation of this porosity however I knew I couldn't leave it like that. The answer came from a fellow club member who suggested using the industrial filler Devcon, which is designed to withstand very high temperatures. This was applied to the aforementioned outside curved face and left to set for a couple of days before testing the chassis on air and applying another round of bubbles. I'm pleased to say that the Devcon did the trick and luckily it would all be hidden from view when the cylinder cladding was fitted. (Photo 2)

When I opened the air valve there was initially no sign of life from the chassis but after a little encouragement the wheels tried to kick round. To start with, they would only do about half a turn at a time before requiring further manual assistance. After a good hour or so of doing this, gradually the motion began to wear in (or should that be wear out) and with each revolution the wheels would rotate a bit further. Following a bit more running in, the chassis was essentially turning over without any assistance and after a further hour or so it was running freely.

Video evidence

I recorded a short video of the running-in process which shows the chassis reliably turning over. The video can be found at: www.youtube.com/watch?v=JLspvMgg8NU

Once the locomotive was successfully running with four evenly spaced beats in each direction, I had to pin the eccentric stop collars in place by drilling into the rear axle and threading it to take a hexagon-head bolt. The temporary hexagon-head bolts in the stop collars were threaded externally 2BA and had a 2mm pilot hole through the centre of them. By using them as a guide, the pilot holes in these bolts allowed me to accurately spot-drill the axles by drilling through them. This was achieved by placing the whole locomotive on the Bridgeport milling machine and clamping it firmly down to the bed.

I rotated the wheels so that the first bolt in the stop collars mentioned above was vertical and I used a drill blank in the mill chuck to establish the centre. The loco was still quite tight and therefore there was very little risk of the wheels turning and altering the position of the eccentrics.

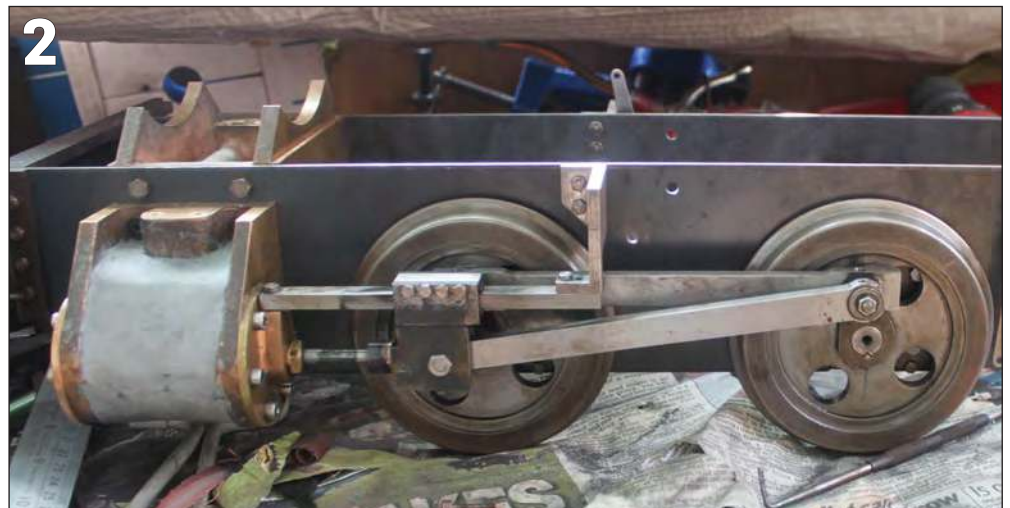


PHOTO 2: The issue of a porous cylinder casting was solved with a layer of Devcon industrial filler.

PHOTO 3: Loco clamped to mill in order to perform drilling and threading operation to lock eccentrics in position.

I drilled through the pilot hole in the bolt into the axle with a 2mm drill to establish a centre before removing the bolt and opening out the hole with a 3.9mm drill. Before moving on to drill the second stop collar, I threaded the first one 2BA ready to accept the hexagon-head bolt that would permanently lock it in position on the axle. (Photo 3)

The above process was then repeated for the other stop collar prior to drilling into the axle for a third time in order to pin the axle-pump eccentric. Unlike the first two stop collars, the position of the wheels for this hole is not important and it was drilled in the same way. Final assembly involved the use of a 2BA grub screw instead of a hexagon-head bolt as the whole bolt must be within the eccentric to allow the strap to run round it.

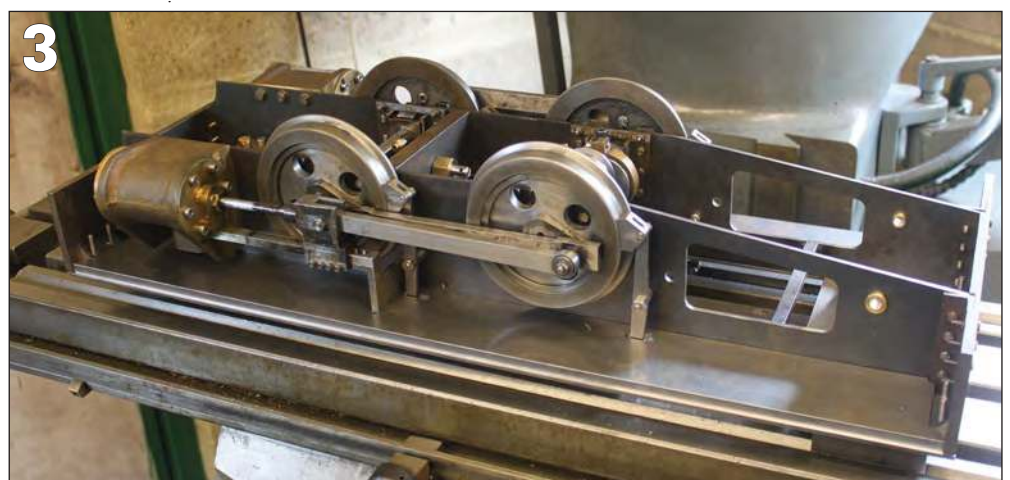
That concluded the main chassis construction but as a final gimmick I was desperate to test the completed chassis on my club track. I lifted the air compressor onto one of our club passenger trucks, coupled the truck to the chassis and experimented to see how far a tank of air would get me round the track. The answer is not very far (about 300 feet to be precise) and unfortunately no photos exist of this test run!

In order to be able to pull a reasonable load, I had always intended to build my Dougal deliberately 'heavy' and so I chose to make the main running plates out of two pieces of 24-inch long x 2½-inch wide x ⅜-inch steel plate. This was probably extra work at the time but has proved to be a very good idea since.

The plates were already the correct length and width when I bought them so they were ready start machining straight away. The first job was to mill away the area where the frames would sit along the inside edge of the plates. Each plate was therefore held in the mill vice to allow me to run a ½-inch end mill along the material. This job had to be split into two halves as the travel of the mill bed was insufficient to complete the job in one go.

I left an ⅛-inch deep (width of the frames) x ⅛-inch thick lip which would rest on top of the frames before turning them over and repeating the process to create a fake valance on the outside edge of the running plates. This was identical to the inside one apart from the depth which was only ⅛-inch.

Next, I had to machine away the area where the angle of the buffer beams sit, again leaving a ⅛-inch thickness of running plate to rest on the top. Midway along the locomotive



4



the motion brackets are designed to act as a support for the running plates but as I was effectively using $\frac{3}{8}$ -inch instead of $\frac{1}{16}$ -inch thick material a slot had to be machined into the underside of the plates to account for the thicker material. This was a delicate operation as I was using a $\frac{5}{32}$ -inch end mill to machine this slot nearly the full width of the running plates and $\frac{5}{16}$ -inch deep. It was also vital that these slots were in exactly the right place so I measured the plates twice to ensure I made no mistake.

I then marked the location of the $\frac{3}{16}$ -inch wide by $\frac{5}{8}$ -inch long slots for the four brake levers and carefully machined these out with an appropriate $\frac{3}{16}$ -inch end mill.

Adding platework

The running plates could now be sat on the locomotive for the first time, allowing me to mark out the position of the eight holes which would hold them down to the buffer beams. These holes were drilled in the milling machine before trial fitting the completed running plates to the locomotive chassis and bolting them down with 4BA Allen-head bolts to the buffer beams, which had been drilled and threaded earlier in the construction. I initially used Allen-head bolts for this operation as the running plates would be regularly taken on and off as the build progressed to mount further

PHOTO 4: Boiler trial-fitted in preparation for weighing – note the heavyweight footplate.

PHOTO 5: A test on the scales showed pleasing weight and potential tractive effort.

PHOTO 6: Neat cosmetic cab steps add to look and correctly replicate the prototype loco.

DRAWING 1: Layout of the running boards – these drawn approx half-size for 5-inch gauge.

components to them. The bolts would later be replaced with stainless steel hexagon-head bolts.

I made the footplate and front section of running plate next and like the side running plates, these were constructed out of $\frac{3}{8}$ -inch steel plate and had holes drilled in each piece to accept the 4BA buffer beam bolts. Firstly, these plates were machined to the correct width to fit in between the frames and to the right length to fit within the available gap.

Then, both pieces had steps machined on the underside using a $\frac{5}{8}$ -inch end mill which would sit over the buffer beam angle. Like before, I machined these steps until the material was a $\frac{1}{16}$ -inch thick, to give the impression of normal thickness running plates.

The footplate is only supported by the bolts in the rear buffer beam and it is therefore important to ensure that the area machined away for the buffer beam is square otherwise the footplate might not sit level. The front running plate has the advantage of resting on a thin ledge at the front of the port & saddle block and so another step was machined into the underside of this plate for it to rest on.

With the locomotive now fitted with running plates all round, I set about making a batch of 14 stainless-steel 4BA bolts out of 5.5mm

DRAWING 1

·375x·375 brass angle

rivet to footplate ·06 brass rivets

·06

position of hand pumps

·328 ϕ for brake standard

bunker side 4 high 18 swg
note prototype has coal bunkers
each side as shown by chain dot line

4 slots position
above brake lever
pivots

to pump feed

brass bush ·5 O/D
·25 ϕ bore

·25x·25 angle rivet or solder
to side panel 6BA bolts to
running board

note 1/16 overlap over frame
by running board

hexagonal material. This was a monotonous task but once they were fitted the running plates could be quickly and simply removed with the aid of a box spanner or socket set.

Weight test

I also took the opportunity to place the boiler on the chassis and weigh the increasingly heavy loco which turned out to add up to an impressive 61.7lb (Photos 4 and 5).

Whilst the running plates were being machined, I decided to make a pair of cosmetic cab steps. These are not included on the drawings so I developed my own design by closely studying photographs of the prototype. They began life as a couple of pieces of 1½-inch x 1-inch x ⅛-inch steel plate and I started by silver soldering a 1-inch wide length of ½-inch x ½-inch steel angle to the top of each plate.

Prior to soldering, I had marked and drilled a pair of 1.8mm holes, equally spaced, onto the top face of both pieces of angle which would be tapped 8BA and used to support the steps off the running plate.

A further two pieces of ½-inch angle were used to create the step itself, however these pieces were ½-inch wide so that the step is wider

"In order to be able to pull a reasonable load, I had always intended to build my Dougal deliberately 'heavy'..."



than the supporting back plate. I machined away most of one side of the angle, leaving a ⅛-inch lip and it was this side that was then silver soldered to the supporting back plate at the opposite end and on the opposite side to the mounting angle which had already been fitted.

The sides of the steps were then made from off-cuts of ⅛-inch plate and likewise soldered in place before I placed the whole step into the vice of the mill and machined them so that they taper down towards the front of the step.

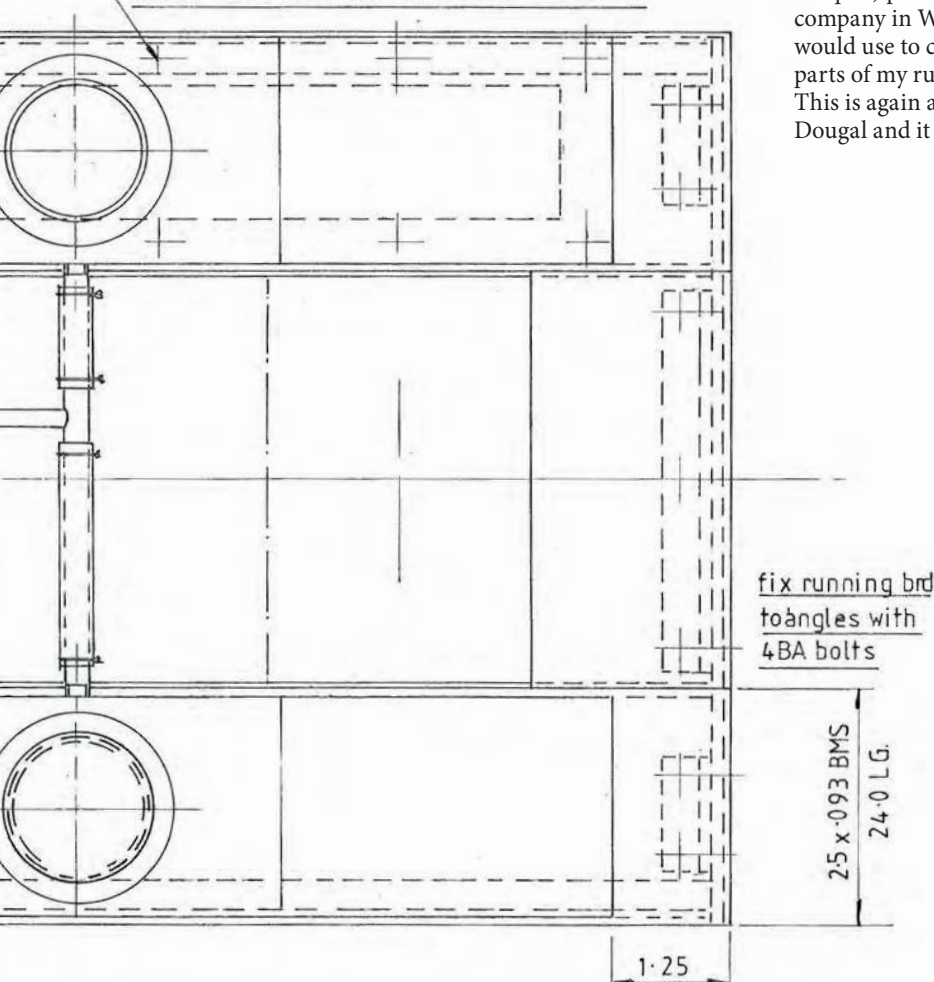
Next, there was a little excess solder to clean up as well as burs to remove following the machining.

Finally, I managed to acquire several sheets of rolled brass diamond (or chequer) plate from a company in Wales which I would use to clad the visible parts of my running plates. This is again as per the real Dougal and it is likewise

used on the treads of the cab steps. I cut out a couple of pieces and tinned the back of them using soft solder. This meant that all I had to do to fix them to the steps was to carefully clamp them in place and then gently warm them up, melt the solder and allow it to stick to the angle underneath (Photo 6). **EIM**



fit tanks to running boards with 4 BA screws tapped into flange on bottom of tank. coat entire area under tank with silicone rubber sealant.



Drawings in this series reproduced with kind permission of A J Reeves. Drawings, castings and material for this build project are available from A J Reeves.

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Web: www.ajreeves.com



Previous Episodes of the build...

Introducing Dougal, April 2018; Building the boiler, May 2018; Frames, axleboxes, June 2018; Wheels, eccentrics, July 2018; Rods, boiler saddle, August 2018; Machining the steam chest, September 2018; Adding the eccentrics, November 2018; Machining cylinders, December 2018; Cylinder covers & slide bars, January 2019; finishing the motion, February 2019.

Digital back issues can be downloaded or printed versions ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by phoning 01778 392484.

Next Month...

"The levers are a strange shape as one side tapers in towards the ends..." Andrew makes his brakes.

A Question of Scale

Some model engineers favour the larger scales, a rising number the smaller – but, Jonathan suggests, what about something inbetween?

BY JONATHAN PALTERMAN

Throughout the history of model engineering there has never been a shortage of scales. Even in the model railway circles a wide array of possibilities exist, some now practically defunct, some very much alive and flourishing. My interests lie conveniently in both model engineering and narrow gauge railways so it might be presumed that I'm well catered for. This is true, except... there are some scales that make more sense to me than others.

As the accompanying photos illustrate, my efforts at present are concentrated on two slightly esoteric scales, 24mm/ft and 32mm/ft. I do also model in 16mm and 7/8n2 (well 22mm) but I have been unable to resist the alternatives mentioned above. I hear a rising cry of "not another scale", but consider the supposed logic...

A popular scale is obviously 16mm/ft; most narrow gauge enthusiasts are likely very familiar with it. Born when early exponents adopted O Gauge track of 32mm (neatly representing 2ft gauge in 16mm scale) and the 45mm track of Gauge One and pioneered by lone modellers the Merioneth Railway Society and then the Association of 16mm Narrow Gauge Modellers and others, the scale has mushroomed in popularity.

Manufacturers have risen to the challenge and today trade support for the scale is wide ranging and to suit every budget. Many fine locos powered by both steam and battery are now plying their way around many a garden or exhibition layout.

The next scale up is the equally delightful 7/8n2; that is 7/8-inch to 1ft normally representing 2ft gauge prototypes running on 45mm gauge track. By comparison to 16mm scale (or near enough 5/8) 7/8n2 is a ratio of 1.4 or 1.375 times bigger.

Some exponents build models based upon 1ft 6in gauge prototypes running on 32mm track, this being only slightly under gauge for scale, and some model 15-inch gauge prototypes again on 32mm track. No matter, everyone copes admirably!

Simple measures

So how does this fit in with 24mm/ft? Using 24mm as a scale works out well for easily sourced metric materials. The 12 inches in one foot divide nicely as well, 2mm representing 1 inch, 1mm representing 1/2 inch and so on.



ABOVE:

Some narrow gauge locos for 2 1/2-inch gauge track on display on the National 2 1/2-inch Gauge Association stand – Steve Eaton's 'Toby' and a WW1 Simplex by Des Adeley.

BELOW: A first effort in 32mm scale – a Penrhyn quarryman carriage.

It does mean that a 1ft 6in gauge prototype in 24mm would need to be running on 36mm track to be true to scale instead of the commonly available 32mm, and that a 2ft gauge locomotive would be using 48mm track instead of 45mm. This won't happen because life is too short to build bespoke track. But considering, for example, that the Penrhyn Quarry Railway utilised 1ft 10 1/2-inch gauge track, we now arrive at a happy compromise. Suddenly on paper at least everything now makes sense. (well hopefully!)

Before anyone cries "foul" and derides this choice, it is no worse than the many who model prototypes from the Tallylyn Railway (2ft 3in in 16mm scale being 36mm) or the Welshpool & Llanfair Light Railway (2ft 6in in 16mm scale being 40mm) and run them on 32 and 45mm track, accepting that the scale and gauge combination are not perfect. We can live with being 3mm out for 2ft gauge prototypes and 4mm out for 1ft 6in gauge.

So far a small variety of rolling stock has been drawn

up and test built. The goods wagons are based on 1ft 6in gauge originals built for the War Office by John Fowler & Co. Leeds. Original works drawings provide a useful basis in 24mm scale, the 1 1/2-inch thick planking scaling to 3mm. Ideal!

The carriage illustrated is based upon the very familiar Penrhyn quarryman carriages, a number of which survive in preservation. The drawing used as a starting point was found in a past issue of the *Merioneth Mercury*. Having completed the drawing for laser cutting, when the test cuts arrived it was straight to work. The overall result of 24mm/ft is, as my wife described it, very 'playable' with. The next carriage under development will likely be a Festiniog Railway 'Bug Box' or Ashbury.

Now, what of the 32mm scale? I am not the originator for either of these scales, and this is particularly so with 32mm or 1 1/4in/ft. A visit in the now very distant past to the Model Engineer Exhibition at Wembley brought me face to face with a superb model of the Lynton & Barnstaple



'Lyn' as displayed on the National 2½in Gauge Association stand. It made a great impression that has taken over two decades to act upon!

The rolling stock modelled thus far is again the quintessential Penrhyn carriage. Drawn up again, this time the luxury of simply doubling the 16mm scale drawing made for an easy life.

The underframe for mounting bearings, axles and wheels will likely be laser-cut steel. A list of suitable prototypes with this scale in mind (with such a large resource of drawings available) might outlast a couple of modelling lifetimes. With the ability to laser cut many components, this hopefully will result in a decent train for the locomotive. Next item for the laser cutter is an early Festiniog Railway single-plank four-wheel wagon.

Locomotive choices

Now some candid honesty here, I have not yet completed a locomotive for the 24mm scale. I have though a couple under construction. For 32mm scale, I have been fortunate to acquire a part-built Quarry Hunslet named of all things 'Penrhyn'. Designed by Tony Weale, this particular example has been progressed thus far by Des Adeley. I've been contemplating construction of the boiler – coal-fired as per Tony's design, or gas-fired like so many small scale locomotives? Time will tell – perhaps I will do both.

The chassis ticks over nicely on compressed air, and so hopefully progress can be made in order to run a completed loco with the waiting rake of Penrhyn Quarrymen carriages.

Other designs for 2½-inch gauge exist, for example the W.G. Bagnall 2-4-0T 'Polar Bear' of the Groulle Glen Railway. As observed at the Midlands Model Engineering Exhibition and the annual Guildford ME Gala, a couple of other designs include a Leek & Manifold Valley Light Railway 2-6-4 Kitson, a First World War semi-armoured Simplex built by Des Adeley, along with a later Motor Rail and Steve Eaton's 'Toby'. Predating all of this in the 1930s, a magazine in the USA featured a WW1 trench railway US Army Baldwin 2-6-2T. I'm still tracking down the last two issues to complete the set.

There is an additional choice, 1/12th scale – 1in/ft, which is very close to 32mm or 1¼in/ft. The list of suitable prototypes is, as has already been mentioned, very wide. 1/12th scale on 2½-inch gauge track would particularly suit any 2ft 6in gauge prototype. I have started sketching out a Sierra Leone Railway 2-6-2 Hunslet as per Welshpool & Llanfair No.85. This locomotive might utilise cylinder castings from the Robin Dyer



"I hear a rising cry of 'not another scale', but consider the supposed logic..."

ABOVE: Also in 2½-inch gauge, Malcolm Brown's Bagnall 0-4-2T 'Jack'.

BELOW: A locomotive project – a 32mm scale quarry Hunslet.

3½-inch gauge War Department 'Spencer' design. Having copies of the Hunslet Engine Co. drawings to reference, the earlier 1898 Sierra Leone 2-6-2T is also a possibility.

An alternative of similar size might be the W&LLR Kerr Stuart 0-6-2T 'Joan'. The recent and currently running series in EIM featuring a 5-inch gauge W&LLR 'Dougal' might be carefully and sensibly halved in dimensions to produce a diminutive but functional scenic 1/12th scale locomotive. For the driving wheels perhaps 'Tich' castings, or maybe the Hunslet pattern 'Spencer' wheels? Though reducing the boiler to 2-inch diameter would likely preclude passenger hauling!?

Along with the variety of locomotives, there would be great choice with regard to rolling stock. The Sierra Leone Railway had a wide range of items, though as the early goods wagons were generally 22ft long, a rake of 22-inch long wagons would start taking up space.

A recent family holiday to Croatia has now highlighted the further

delights of the 'Bosnian gauge' (760mm or 2ft 6in). Though we were 83 years too late for the last train on the Parenzana Railway, all that can be said is that it clearly had some delightful locomotives and rolling stock... An overwhelming feeling of being 'a kid in a candy store' starts to become apparent in considering all the possibilities.

To conclude, the overall intention of this article is not to encourage or incite a mass conversion from 16mm or 7/8in2 – given the investment in these scales that would be both unrealistic and unlikely. Additionally they are also perfectly functional.

For those happy to experiment, however, or who maybe prefer the challenge of building in a scale not so readily supported by the trade, then 24mm/ft, 1/12th and 32mm/ft are worth considering. There is more information concerning some of the 2½-inch gauge designs on the National 2½ in Gauge Association website (www.n25ga.org). And anyone seeking a real challenge might consider a South African Railways NGG16 Garratt or Vicinongo Railway 2-8-2 Bagnall tender locomotive.

Whatever your tastes in modelling scales, just remember above all else to have fun! **EIM**



Turning perfect tapers on mating parts

The latest in John's useful advice series for workshop novices.

BY JOHN SMITH

There is one place on almost every locomotive, traction engine or stationary steam engine where a perfect tapered fit is required. This is the connection of a piston rod to its crosshead (**Photo 1**).

The way to achieve this is to make the required number of piston rod blanks from precision-ground 316

stainless-steel rod or silver-steel rod. All that is needed are blanks with the crosshead end faced and the piston end left (say) 10mm over length to allow it to be finished to size and threaded once the crankshaft/ crankpins, connecting rods, crossheads, slide-bars and cylinders have been assembled and it is time to

finish the piston end of each rod to achieve the same clearance at each end of the stroke.

Bore the crosshead taper first, using as large (and therefore rigid) a boring tool as possible, the top-slide being set at an appropriate angle for this operation.

Then, without changing the top-slide angle, the crosshead end of the mating piston rod is machined. To do this, use a tool cutting on the rear of the piston rod with the lathe running in reverse.

This dodge is also useful when machining the inside of a safety valve bonnet (**Photo 2**) and the outside of a mandrel (**Photo 3**) to hold the safety valve cover for the turning of its outer profile. For this purpose, it will even be possible to use the same boring tool that was used to bore the inside of the bonnet.

Note the screw thread in the mandrel. This, in conjunction with a suitable disc and an M8 Allen screw, allows the bonnet to be secured on the mandrel to ensure that it cannot come loose during the machining of the outer surfaces.

316 precision-ground stainless steel ground bar is available in the UK in metric sizes, and from the US in Imperial sizes. You will likely have to buy at least a metre though! **EIM**

PHOTO 1:

Crosshead to piston rod – a perfect tapered fit is required.

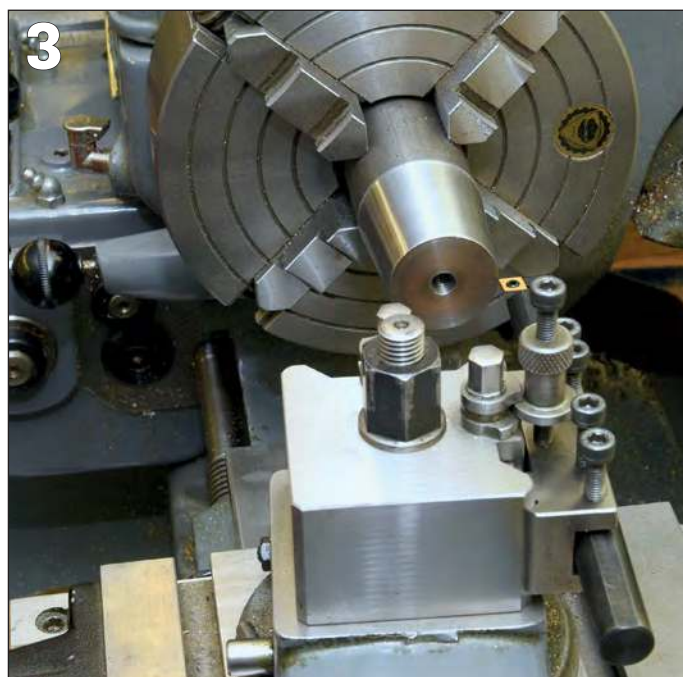
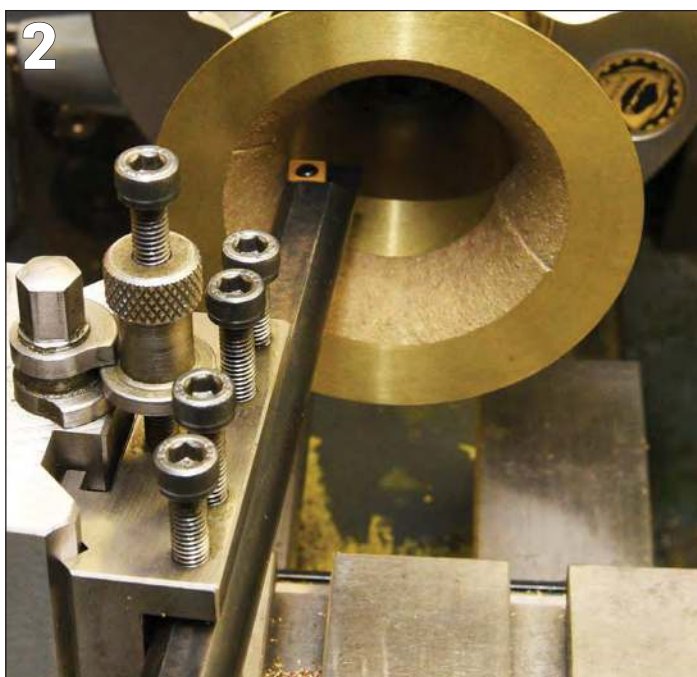
PHOTO 2:

John's tip works just as well when machining the inside of a safety valve bonnet...

PHOTO 3:

...or the outside of a mandrel.

All photos by John Smith



Retro-fitting an LED lamp

Peter describes a minimally-invasive installation on his Harrison lathe.

BY PETER KENNINGTON

This article describes a circuit and mechanical arrangement to allow an existing machine lamp-holder to operate with a commonly-available low-voltage LED bulb, with virtually no modifications being required to the original lamp-holder and no modification at all to the electrical circuits of the machine – the light will switch on using the machine's original lamp switch, for example.

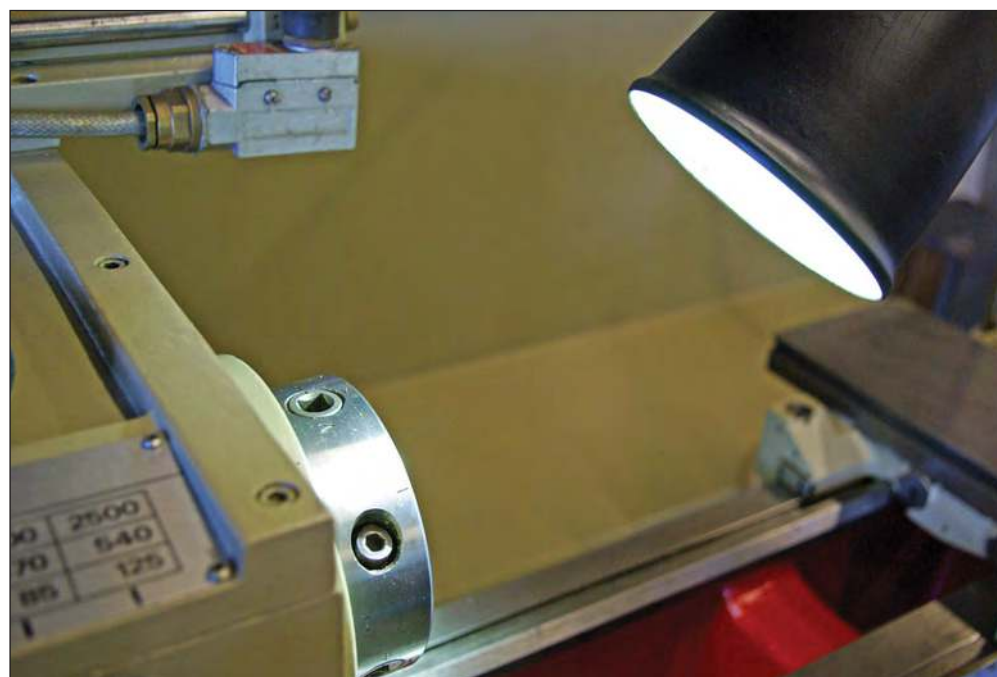
The installation is completely safe, electrically-speaking, as it converts the existing supply to 12V DC. Conversion to a smoothed DC supply also has the benefit of eliminating strobing, a problem with some LED lighting solutions; strobing can make a rotating workpiece or chuck appear to be stationary or only moving slowly, which can be potentially dangerous. The circuit is very simple and will work with any AC supply from 15V to 50V, thereby covering the two most common machine lamp voltages, namely 25V and 50V.

Background

I'm in the process of refurbishing a Harrison M300 lathe and am trying to 'future-proof' it as much as possible. The lamp assembly takes a standard bayonet-fitting GLS incandescent bulb, with the crucial exception that it needs to run at 50V AC. The low operating voltage is a sensible precaution for something used in close proximity to both rapidly-moving workpieces (or even tools, if things go wrong!) and a largely water-based suds system. Although such bulbs are still available (just) they are getting increasing hard to come by and, at some point in the future, will become unobtainable. I therefore decided that a change to a more modern lighting system was in order now, whilst the lathe is undergoing other refurbishment work.

One common solution I've seen discussed is that of removing the original lamp assembly and replacing it with either a halogen or LED gooseneck lamp, running from its own plug-in mains supply. Whilst these are not overly expensive, they do rather depart from the aesthetics of the original machine and are often not as robust as the original system.

As my background is in electronics (this mechanical stuff is an exciting new avenue for me), I thought that there must be a way of preserving the



original lamp system on the lathe and its electrical functionality (switch, fuse arrangement and such) whilst upgrading to a modern LED solution. The system I came up with is both simple and aesthetically pleasing, leaving the lathe indistinguishable from its original form. It also allows the possibility of restoring the original incandescent bulb system very easily, should the need ever arise, and does not require any new holes to be drilled in any part of the lathe or its original lamp system. I have tried to describe the solution in very great electrical detail, in the hope that even those nervous of electrics will feel sufficiently confident to have a go.

Components Required

The following components are needed for this project (as well as the original lathe and its lamp fitting, of course):

- 1) Veroboard copper strip board (0.1-inch matrix, 1mm holes). A piece featuring 21 strips x 19 holes in size is needed, with overall dimensions of 50 x 58mm (don't worry if you end up with more strips than I did – I used an old off-cut edge piece which had an un-clad border)
- 2) 3-off copper 'nuts', 10 x 12mm (tapped: M3.5). I made these (somewhat crudely!) out of an off-cut of 3mm thick copper strip. As an alternative M3.5 brass nuts would also be fine, as these can be soft-soldered
- 3) MR16/GU5.3 lamp-holder (pictured on the right in **Photo 1**) plus suitable

M3 bolts to hold it in place (Allen-bolts fit nicely). Mine cost £1.69 for two from eBay (UK stock)

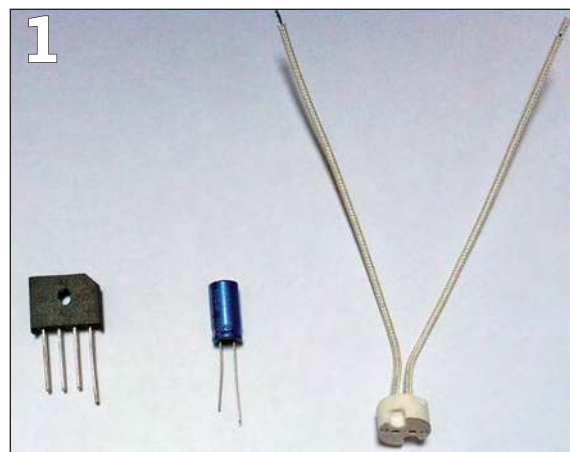
4) 12V MR16 lamp. I chose a 6W lamp, but other power ratings are available. Cost was £8.45 for 4-off from ebay, UK stock – only one is needed, of course, the remainder likely constituting a lifetime's supply!

5) 100µF, 100V radial (or axial) electrolytic capacitor – £2.19 for 10-off from eBay, UK stock. Again only one is needed, but I will probably use at least some of the remainder one day. An example component is shown in the middle of Photo 1. The capacitance value is not critical, anything larger than 100µF will be fine and smaller values, e.g. 47µF, will probably also do, if you have something suitable lying around. Note that the 100V rating should be treated ▶

ABOVE: The completed fixture lighting the scene.

PHOTO 1: Lampholder and electrical components for the conversion.

All photos and drawings by Peter Kennington.



as a minimum, however; the next step down, 63V, is cutting it too fine.

6) KBU8D Silicon bridge rectifier, 8A, 200V. Cost £1.99 for two from eBay, UK stock – again, only one is needed.

An example component is shown on the left-hand side of Photo 1. Many other bridge-rectifier components could be used instead; any rated at 100V, 2A or more should be fine

7) LY-KREE K481201 DC-DC converter (15 – 58V DC input, 12V DC output @ 3A). Cost £6.99 from eBay, UK stock. In practice, any suitable DC-DC converter will do; the important parameters are: >>50V DC input capability (58V is fine), 12V DC output @ >~10W (most MR16 LED bulbs are ~3 – 6W)

8) Two-pole piece of 'chocolate block' terminal block connector, ideally 3A

9) Wire, solder and such like.

The total cost (excluding Veroboard, nuts/bolts, chocolate block connector and wire) is £21.31 (or £11.17 if you can sell off the spare bits to friends!). All parts are available much more cheaply from China, if you are prepared to wait for delivery, perhaps saving close to 50 per cent.

It might also be worthwhile to invest in a spot-face cutter, for cutting the tracks in the Veroboard (as will be

discussed later) – this is essentially a straight-fluted drill-bit with a handle. Alternatively a 3.5mm or 4mm drill bit can be used instead – this is hand-held, do not use it in an electric or hand drill.

The mounting-plate for our circuitry and new lamp-holder is the existing lamp-holder mounting plate from the lathe (Photo 2). To remove it, firstly, isolate the machine from its mains supply before proceeding, then remove the existing bulb, if one is present. This will reveal three machine screws which attach the lampshade to the remainder of the lamp body – these need only be

FIGURE 1:

Dimensions of circuit board and associated mounting hole locations, in correct location on lamp back-plate.

FIGURE 2:

Circuit diagram.

FIGURE 3:

Circuit board connections.

FIGURE 4:

Main circuit components and pinouts; (a) Bridge rectifier, (b) DC-DC converter.

loosened and the lamp shade then rotated to allow it to be removed.

With the lampshade out of the way three further screws are revealed and these should be removed to free the lamp-holder mounting plate. The two wires can then be disconnected and the brass bayonet fitting removed, leaving the bare lamp-holder mounting plate itself.

Cut the circuit board to size, 21 strips x 19 holes, with overall dimensions of 50 x 58mm. The size is not overly critical, so long as the components will fit and the mounting holes can be accommodated. Drill the three mounting holes to M3.5 clearance – the lamp-holder mounting plate can be used as a template (which is what I did, rather poorly!).

Find the centre of a circle whose circumference intersects the three holes just drilled and, using this centre as a reference, measure/drill the four MR16 lamp-holder holes – the two larger holes are 3mm diameter for the mounting bolts and the two smaller ones are 2.5mm diameter to accommodate the wiring (Figure 1). The drilled board should look like Photo 3, although hopefully a little better executed than mine.

Photo 3 also shows three 'nuts'

FIGURE 3

To 'chocolate-block' terminal connector

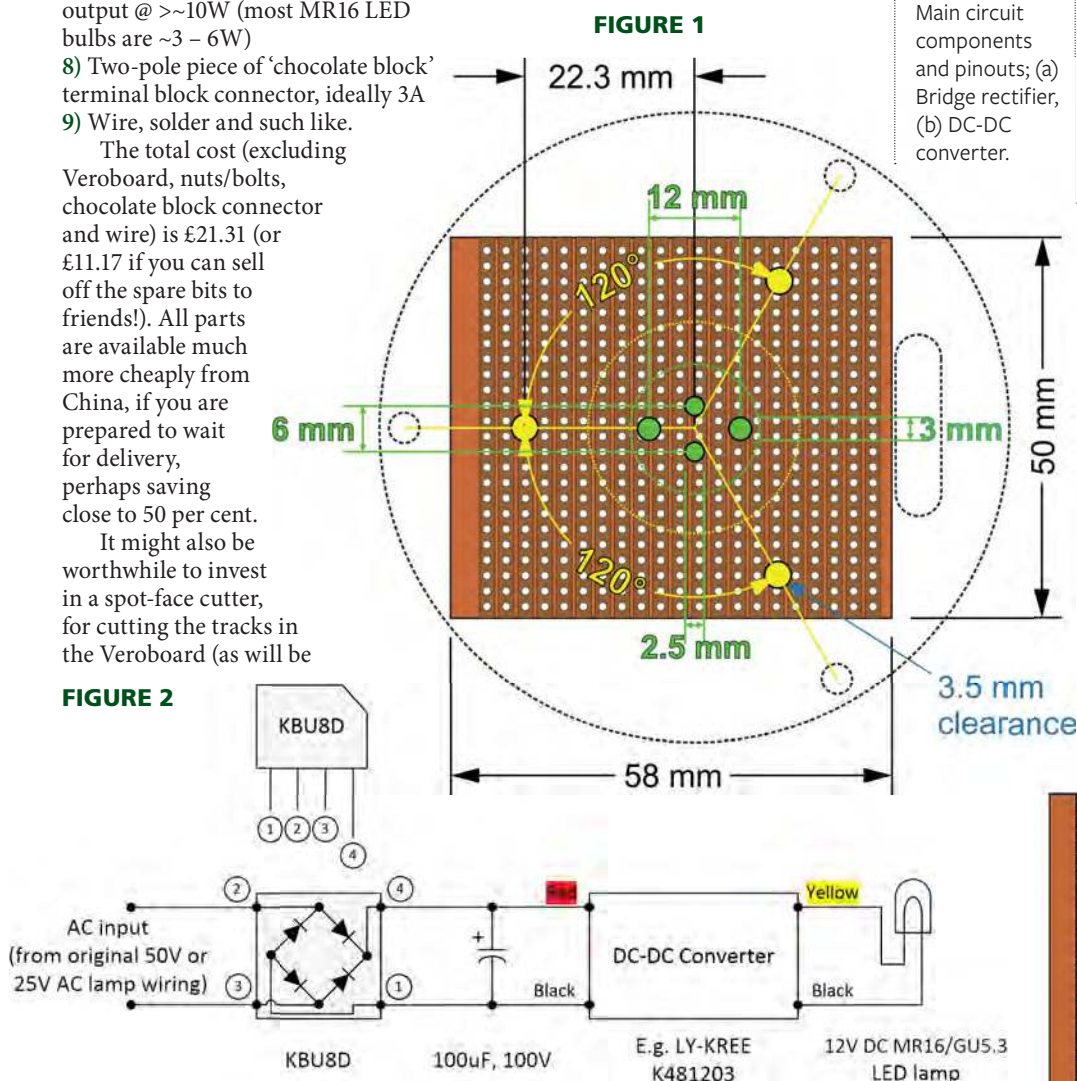


FIGURE 2

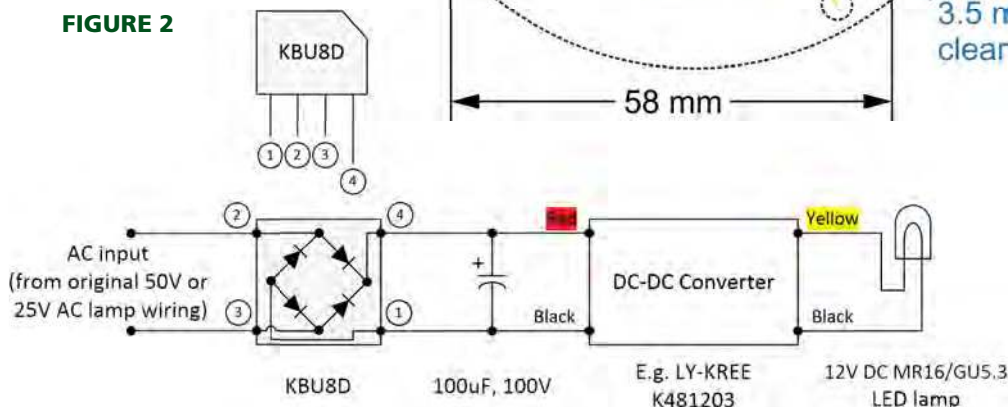
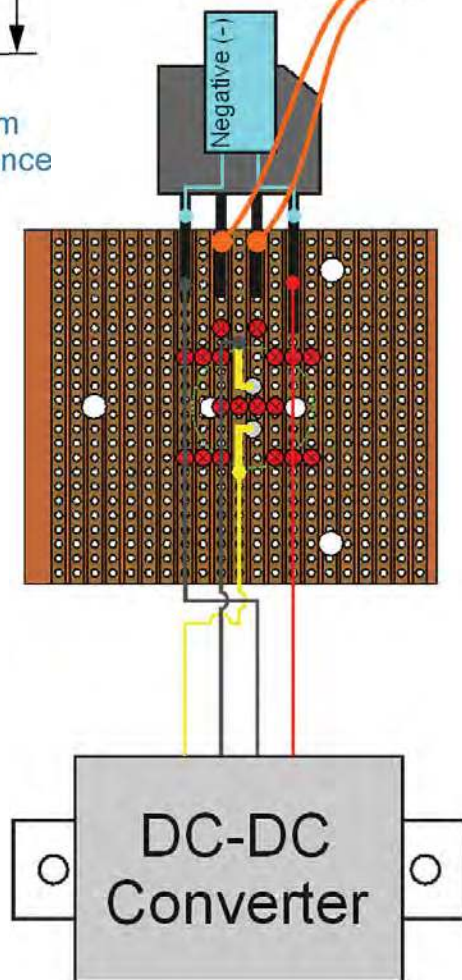
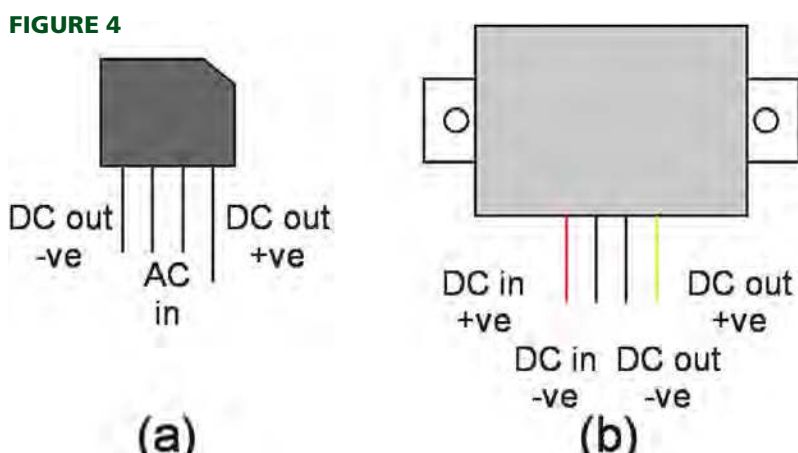
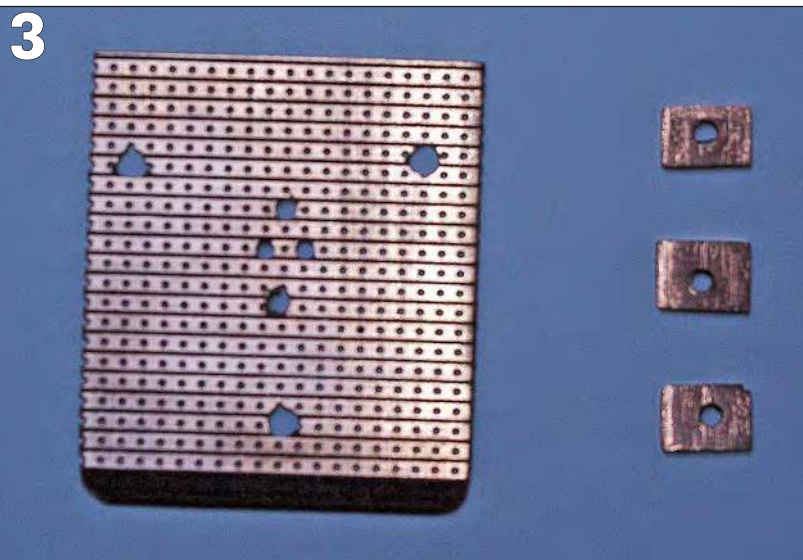


FIGURE 4





which were made from a scrap piece of 3mm thick copper strip. These are approximately 10 x 12mm although their dimensions are not especially critical and they are tapped to M3.5. Alternatively, M3.5 brass nuts may be used – the key thing is that these nuts need to be captive and I achieved this using soft-soldering. I don't quite trust glue for such things although this is also an option if suitable brass or copper nuts are not available.

To attach the nuts, I assembled the circuit board, lamp-holder mounting plate and nuts and then soft-soldered the nuts to the tracks on the circuit board – this ensured that they were in exactly the correct place. The MR16 lamp-holder can then be bolted into place using Allen bolts and, all being well, you should end up with something that looks like **Photo 4**.

Circuit Construction

The circuit we are going to build is shown in **Figure 2**. It consists of a bridge-rectifier to convert the 25V or 50V AC which powered the original incandescent lamp, to 25V or 50V DC ready for conversion to the 12V DC needed for the LED lamp.

One thing to note here is that the load regulation of the lamp transformer should be checked, if this circuit is to be used on other than a Harrison lathe. This is simple to do using a multimeter set to measure AC volts. With the lamp-holder removed and the mains supply still disconnected, attach the lamp wires from the machine (which were disconnected from the lamp-holder, as described above) to the leads of the multimeter, using crocodile clips or just insulating tape.

With hands well clear and the bare ends of the wires not touching any metalwork, turn on the machine supply and then the machine light switch. The voltage measured on the multimeter will then display the

no-load voltage of the transformer. Since our LED light will draw relatively little current compared to the original incandescent lamp, this voltage will be fairly representative of what our circuit will run at when operational. We don't want this voltage (when converted to DC) to exceed the rating on the DC-DC converter.

On the Harrison lathe, the no-load voltage was around 53V, which is fine. If the voltage measured gets close to 58V or, worse, exceeds this value, then a load resistor will need to be added either across the AC input to the bridge rectifier (terminals 2 and 3 in **Figure 2**) or across its output (terminals 1 and 4). This should bring the voltage down, closer to its rated 50V. A value of around 470 ohms would probably be a good place to start, with a power rating of 1W or greater. Load regulation is, of course, not an issue if converting a 25V AC lighting system to LED, since even a poorly-regulated transformer will not output over 50V under no-load conditions.

It will be noted that no fuse is included in the circuitry shown in **Figure 2**. The original transformer and lamp system on the Harrison are very well fused in the transformer unit housing and this is adequate for our needs. Other machine lamp systems are also likely to be well designed in this regard, but it is probably worth a check – involving either a physical inspection or an examination of the circuit diagram.

The circuit layout is shown in **Figure 3**. The first task is to cut the copper tracks at the positions shown by the red circles with a black 'X' in the centre. As noted above, this can be achieved either using a spot-face cutter or a 3.5mm drill-bit held in a (preferably gloved) hand.

The MR16 lampholder can then be added and bolted in place, with the two lamp connections then being

soldered along the tracks as shown by the thick yellow lines emanating from the lamp connection holes. The insulation covering the wires can be removed entirely to make these connections, once the wires have been shortened to an appropriate length. The individual wire strands should be twisted together to preserve the integrity of the wires when undertaking the soldering operations.

Note that none of the connections should be made through the small grid holes in the circuit board (as would normally be the case with this type of board), as there is a severe danger of shorting to the metal of the lamp-holder mounting plate – all connections should be mounted on the copper surface of the circuit board only.

The next step is to mount the bridge-rectifier as shown in **Figure 3** (with its pinout being shown in **Figure 4(a)**); all leads can be shortened as needed and the longer lead can be made the same length as the others – it is only shown longer in **Figure 3** to make the connections clearer.

The bridge-rectifier can then be

PHOTO 2:

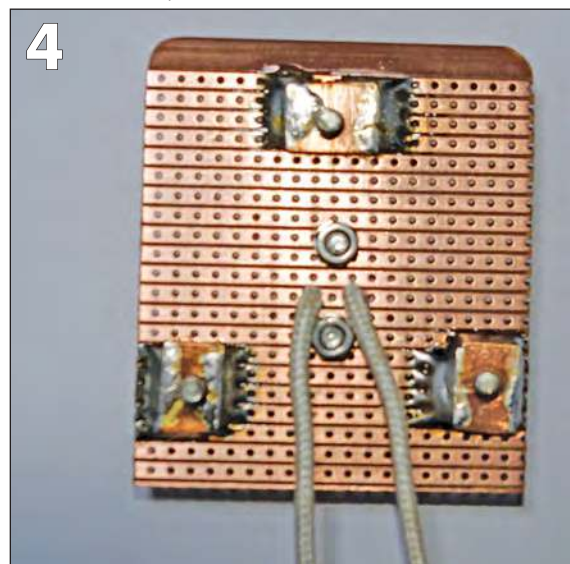
The existing lamp holder mounting plate after removal from the lathe.

PHOTO 3:

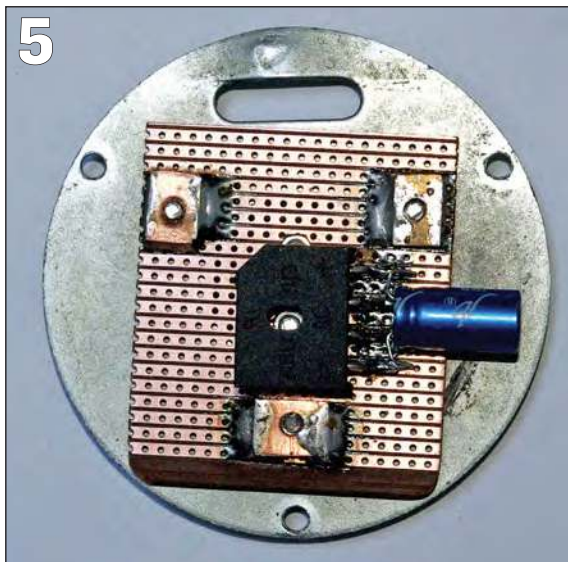
Drilled circuit board and the three 'nuts' made from scrap.

PHOTO 4:

Circuit board once the lamp-holder has been bolted on.



5



'folded over' to cover the lamp connections, as shown in **Photo 5** and **Photo 6**. The capacitor is mounted on the outer two leads of the bridge rectifier, being careful to orientate it correctly as shown in Figure 3 – the negative connection will be clearly identified on the capacitor's case using a "-" symbol and, typically, arrows pointing down toward the relevant connection wire.

If the capacitor is reverse-connected, it will typically 'positively disassociate' (i.e. explode) and make a considerable mess, so this is one to avoid. The capacitor's leads should be bent appropriately to ensure they cannot touch any other connections and, ideally, insulating sleeving should be used to guarantee this (although I didn't).

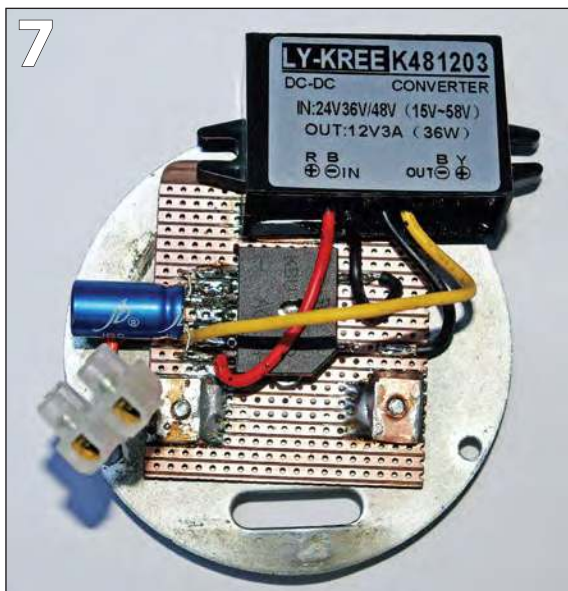
The connections to the existing lamp wiring will be made using a two-terminal piece of 'chocolate-block' screw-terminal connector (**Photo 7**); the 3A rated variety is the smallest and neatest. This chocolate block is connected to the circuit board using a short length of twisted-pair, multi-

PHOTO 5 & 6: Fitting the bridge rectifier.

PHOTO 7: 'Chocolate-block' screw-terminal connector used to join to existing lamp wiring.

PHOTO 8: First test and all seems well.

7



6



strand, wire. This can be made from any suitable wire off-cuts lying around in the workshop and only need be a couple of inches (5cm) long. It is connected as shown by the orange wires in Figure 3 and, since this is a connection to an AC circuit, it doesn't matter which way around the wires are connected (hence they are not individually colour-coded in Figure 3).

Note that the cable used in the lamp-holder of the Harrison lathe is colour-coded (despite it carrying AC), however it can be wired either way around to the chocolate block connector, when the time comes.

Finally, the DC-DC converter can be connected as shown in Figure 3, with the connection colour code being shown in Figure 4 (b). The wires should be cut to a suitable length, for neatness. The completed circuit will look something like Photo 7, once mounted onto the lamp-holder mounting plate using the three original M3.5 screws (the ones used to mount the lampshade). Note that these screws should not be tightened at this stage, plenty of thread needs to be visible to accommodate the lampshade when it is re-instated.

The final step is to re-mount the lamp-holder mounting plate into the lamp assembly on the lathe, using the three outer holes on the lamp-holder mounting plate and the original screws. The bulb can be inserted at this time, ready for an initial test (**Photo 8**).

To test the circuit, the mains supply should be reconnected and the lathe turned on at its isolator switch.

The lamp can then be turned on using its dedicated switch (located on the rear of the lamp base/transformer housing on the lathe). All being well it should glow nice and brightly.

Finally, the lampshade can be re-instated by placing it over the three circuit board/lampshade mounting screws (discussed above) on the lamp-holder mounting plate and twisting clockwise, before tightening the screws. Temporarily removing the bulb will ease access for this task.

Brighter and cooler

The lamp should now operate as did the original, but with a brighter light and cool-running – and no strobing effect (**heading photo**). Note that the MR16 lamp does not need to be inserted in a particular orientation, despite it being a DC lamp using LEDs (which are inherently 'one-way'); the lamp has internal circuitry which can cope with either polarity on either pin.

One final note: the MR16 lamp and lampholder may not prove to be sufficiently tight-fitting in the long term – the mechanical mounting of the lamp into the holder is certainly not as secure as the original bayonet lamp fitting; I may therefore add a small amount of weak glue or a blob of paint between the lamp pins to glue the lamp to its holder, in order to prevent the lamp from shaking loose (should this prove to be a problem). The lamp's life is alleged to be 20,000 hours (around 10 years at 40 hours/week usage) so when the time comes a little hassle in removing it to replace the lamp is probably acceptable. **EIM**

8



Gas-fired vertical boiler for the EIM Steam Plant

Martin begins to silver-solder the boiler for the EIM Steam Plant beginners project.

BY MARTIN GEARING - Part 6 of a series

We are now ready to begin silver soldering the boiler components together. I would suggest that beginners arriving at this point would benefit by going back and reading the notes given under the heading of 'Silver Soldering the parts together' in the episode describing assembly of the Steam Plant lubricator (EIM December 2017).

I should perhaps take this chance to sort out what is the correct (exact) terminology for the process commonly referred to as 'Silver Soldering'. Unfortunately there is a long accepted common interchange of terms which is guaranteed to cause great misunderstanding to any newcomer.

Johnson Matthey, one of the oldest suppliers of the product in the UK, quotes that "Soldering takes place below 450°C and brazing takes place above 450°C." And; "Silver brazing uses filler materials containing silver that melt between 600°C and 900°C, below the melting point of the metals being joined." Also; "Silver soldering/ Hard soldering are terms synonymous with Silver Brazing (not soldering)."

For my sins please forgive me for choosing to use the term 'Silver Soldering' throughout and not the technically correct 'Silver Brazing'. It is my reason for referring to 'silver solder/soldering' rather than just 'solder/soldering' which has a good chance of being misinterpreted in the beginners' home workshop!

The fact that a previously silver-soldered joint requires a slightly higher temperature than that used to flow the silver solder originally, is accepted practice. This feature may be further enhanced by what is referred to as 'Step silver soldering'.

When there are a number of components to be assembled in close proximity to one another, it is sometimes advantageous to use silver solders containing different percentages of silver that melt/flow at different temperatures. If the assembly process is planned to use a higher melting-point silver solder first, then additional parts can be added in close proximity using a lower melting-point silver solder, safe in the knowledge that the first joints will be less likely to re-melt, because of the greater temperature difference.

Constructors with a great deal of equipment and experience in Silver soldering will doubtless feel 'Step silver soldering' is unnecessary on a boiler of this size. For the beginner however, the added temperature difference results in a great reduction in the concern/fear that previous joints may be compromised as the work proceeds. The only trade-off is that working at a higher temperature reduces the time the flux remains active, but is not a problem if the work is done in an organised manner.

Given these comments I am going to recommend using the following two grades of silver solder, both used with a common flux referred to as EF or Easy-flo. This has a medium to long active life, a working range of 550–800 degrees C, and is soluble in warm water after use, making cleaning up easier.

The first stage will use a silver solder with a silver content of either 38 per cent or 40 per cent (depending on supplier) that has a working range of 650–720 degrees C.

The second and final stage will use a silver solder with a silver content of 55 per cent that has a working range of 630–660 degrees C. This is probably the most popular silver solder used in the home workshop.

Assembling tubeplates and stays

Refer Drawing BAVL&R (series part 1, EIM October 2018)

Collect the following components together: 2 Tubeplates, 19 tubes, 6 inner stay nuts, 3 upper stay nuts, 3 lower stay nuts, 3 stays and 3 smoke box tube plate flanged bushes – refer back to Photo B40 (EIM Feb 2019).

These items all now require to be submerged in pickle to remove all traces of oxide/contamination. I have found a plastic carbonated 2-litre drinks bottle works best, with some 1.5mm holes (easiest created with a hot wire) made in the lowest part of the base profiles, to allow draining and the top cut off and a copper wire handle fitted was absolutely ideal (Photo B42).

After 10 to 15 minutes, lift the parts container and wait to allow as



"Working at a higher temperature reduces the time the flux remains active, but is not a problem if the work is done in an organised manner..."

much pickle to return to the container as possible, before submerging in a bucket of clean water, lowering and lifting the parts container several times to rinse all traces of the pickle from the parts completely. They may then be removed and scrubbed with a nylon brush in the bucket of water to remove any residue.

First soldering stage

38% or 40% Silver solder – 650–720°C, EF flux.

Preparation for Silver Soldering

1) Taking a length of 1.5mm diameter Silver solder with either 38 or 40 per cent silver content, form 38 rings of a diameter that fits snugly onto the 5/16-inch diameter firetubes, six rings for the 6mm diameter stay nuts and

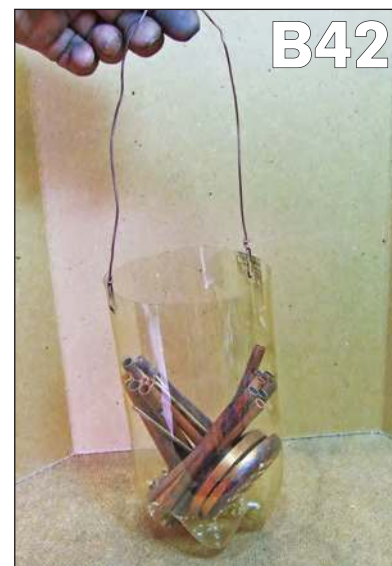


PHOTO B42

Plastic bottle method for submerging components in the pickling solution.

All photos and drawings by Martin Gearing



three rings for the flanged bushes which will be 9mm diameter.

This is quickest done by winding a coil of silver solder wire around a former of a diameter about one third less than that required. Some trial and error is necessary! (Photo B43).

Fit the coil onto the chosen diameter of tube/nut, then cut the coils one by one to form rings, straightening the helical curve from them after cutting so that they lay flat (Photo B44).

2) Mix up a quantity of Easy-flo flux with water that has had a few drops of



washing-up liquid added, which will aid application.

3) Take a stay (B9), flux the end having 12mm length of thread, run on an inner stay nut (B8) with the grooved face facing outwards, before passing it through a stay hole in the firebox tube plate (B3) passing from the flanged side to the plain side, and screw on the blind lower stay nut, (B7). Holding the stay, tighten the lower stay nut fully onto the stay, then undo the inner stay nut until it becomes tight against the inside of the

firebox tube plate. Repeat for the remaining two stays. 4) Flux the three threaded stay ends now assembled into the firebox tubeplate running an inner stay nut (B8) on each one, with the grooved face facing outwards, before passing them through the three stay holes in the smokebox tubeplate (B4), from the flanged to the plain side.

Thread on the three upper stay nuts loosely (B10) with the grooved face facing the tubeplate. Adjust the distance over the outside of the plain surfaces of the tube plates by rotating the inner stay nuts and upper stay nuts together until a dimension of 119mm is achieved when all three pairs of nuts on each stay are tight. Put to one side (Photo B45).

Initial Assembly of Cartridge Refer Drawing BAVL&R

1) Apply flux to each of the three stays/nuts, 19 firetube holes, three tubeplate flanged bush holes, and the immediate area around them on both sides of the smokebox tubeplate.

2) Fit a silver solder ring onto the parallel end of each firetube sliding it along the length until it

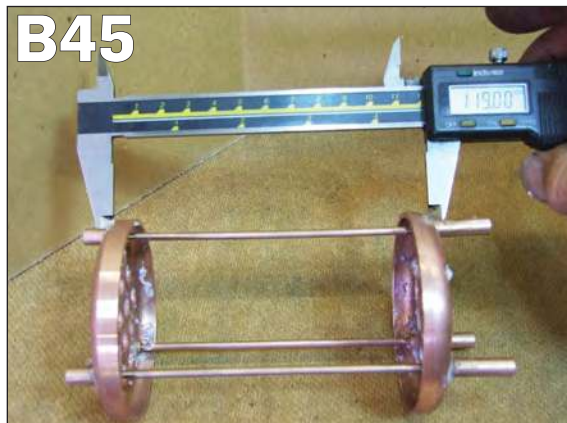


PHOTO B43

Coiling silver solder wire round a former to produce rings.

PHOTO B44

Completed set of rings.

PHOTO B45

Checking distance when tightening stays on tubeplates.

PHOTO B46

Tubeplate coated with flux ready for soldering.

PHOTO B47

Flux has gone transparent (this is earlier version before using alignment links to ensure guaranteed position of bushes).

PHOTO B48

Checking to ensure smooth solder fillets

PHOTO B49

Protection plugs should be removed while still hot.

PHOTO B50

Firebox end fluxed ready for soldering

PHOTO B51

After heating the result is good well-flowed fillets of solder.

rests at the flared end. Flux around the end of the tube and the ring of silver solder.

3) Insert the firetube into the smokebox tubeplate sliding it through and out of the firebox tubeplate.

Repeat for the remaining 18 firetubes.

4) Install the silver solder rings to the three upper stay nuts after coating the area around the nuts and the tubeplate with flux.

5) Flux the 8mm diameter turned portion of the flanged bush and the bush hole in the tubeplate before inserting the three flanged bushes.

6) Fit each bush with a silver solder ring and apply additional flux over the rings.

7) Screw into each flanged bush (B5) a long protection plug (B14A) tightening only finger tight.

8) Fit over the 5mm diameter ends of each long protection plug an alignment link then swinging round and dropping onto the adjacent plug until a triangle is formed, with one end resting on the plug and the opposite end resting on the next link.

Because the tubeplate bushes are very close to the radiused edge of the flange this will ensure that the tubeplate bushes remain vertical.

9) Finally check that both sides of the tubeplate are coated with flux (Photo B46).

Silver Soldering the Cartridge

Transfer the fluxed 'cartridge' to the brazing hearth, standing it on the three lower stay nuts on a square of firebrick or steel plate not less than 3mm thick, placed on top of a level fire resistant block at the base of two walls set at 90 degrees to one another, with about 60mm clear space between the cartridge and the two walls.

The reason for setting the cartridge on the additional square of heat-resistant material is so you can rotate the cartridge – making it easier to heat and examine all of the parts evenly whilst retaining and reflecting as much of the heat as possible within the two walls.

Remember that we are using a



B48



Silver solder in the medium heat range, and that this is less tolerant of prolonged heating, so the aim is:-

- To bring the temperature of the metal up **quickly and evenly** to a temperature at which the solder will flow by virtue of the heat from the metals temperature.
- Maintaining the temperature only for as long as it takes to check that the silver solder has flowed correctly at all the joints.
- Allowing to cool before pickling.

Use a medium to large-sized burner, direct the flame at the underside of the tubeplate tube/stay nest, whilst slowly moving from side to side between the two firebrick walls, raising the temperature of the tubes and tubeplate evenly.

The flux will bubble as the water is driven off, and you may need to reposition the silver solder rings with your scratch stick if they become dislodged. As the metal approaches dark-red heat the flux becomes transparent. (Photo B47).

Continue heating until the metal just approaches a lighter red, watching carefully as this is the temperature at which the silver solder will begin to show signs of 'slumping' immediately before flowing. The heat may now be applied above and below the tubeplate to ensure completely even heating with no cool areas.

Examine each joint in turn, turning the cartridge on the square of heat-resistant material if necessary, checking for a visible smooth silver solder fillet and if necessary easing round with the scratch stick to complete the fillet. (Photo B48).

When satisfied that all the joints/fillets have formed remove the gas torch. Remove the protection plugs whilst still hot, as they will become

B49



very difficult to turn when the flux cools (Photo B49). Allow the assembly to cool before carefully submerging in the pickle. Resist the temptation to place the cartridge in the pickle whilst it is still hot for three reasons:-

- Firstly, there is a danger that the thermal shock could fracture a joint.
- Secondly, there is a very real risk that the hot metal will cause the pickle to bubble and spit violently over you, causing a real risk of physical harm. It is also a tremendously effective and swift way of destroying clothing!
- Any assembly containing tubes, holes or voids of any size or quantity, presents a higher risk of 'flashing off' the liquid to steam, as one end enters the liquid causing steam to spurt out of the open ends.

It pays to get into the habit of making sure that no open end is facing you regardless of what the liquid is, or how sure you are of what the temperature is.

Whilst in these days it might be frowned on, a very reliable way of gauging when the temperature of the mass of black copper has dropped to a safe level, before placing in the pickle is to allow a drop of spittle to fall on the surface of the metal. If it's too hot, then it will form a ball and run across the surface before disappearing! ►

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B50



B51



B52



When the metal drops to a safe temperature, the spittle will lay and remain as a small 'puddle'.

Leave in the pickle for 20-30 minutes before draining and then submerging in clean water for a similar time. Go over it with a toothbrush or nail brush, cleaning away any residue whilst rinsing in cold water.

Check all of the joints on both sides for a visible smooth fillet. Should any joint be suspect, reflux both sides, add short lengths of silver solder if there appears to be a shortage of silver solder and reheat, keeping any short lengths of silver solder in position and encouraging the fillet to form with the aid of the scratch stick. Pickle/clean as before.

Having achieved satisfaction at the smokebox end, flux both sides of the firebox tubeplate paying particular attention around the tubes and stays at the point where they enter the tubeplate, and flux the inside of the smokebox tubeplate thinly covering all of the joints previously made. Install silver solder rings to the tubes and stay nut, applying additional flux over the rings (Photo B50).

Place the fluxed cartridge back on the brazing hearth, on the square firebrick, in the same position as before, but now stood with the firebox tubeplate uppermost standing on the three long upper stay nuts. Repeat the heating process, applying

the flame below the tubeplate and moving side to side to bring the temperature up evenly.

Continue heating until the flux becomes transparent, the silver solder slumps and then flows, bringing the heat above and below as you check for visible signs of smooth even fillets around each joint (Photo B51). Allow to cool, pickle rinse, clean and check as before.

At this point a boiler inspector would almost certainly want to view the cartridge assembly.

Insert Cartridge & Silver Solder Upper Bushes – Refer Drawing BAVL&R

Make up four further rings of 1.5mm diameter 38/40 per cent MT silver solder to fit snugly outside the 3/8-inch x 32 screwed bushes. Clean up the area around the four bush positions on the inside/outside of the boiler barrel and all around the inside surface for at least 50mm in from the machined ends. Make wire wool plugs to fit snugly inside the 19 tubes, these are used to prevent the chance of burning the tubes/melting when soldering the tubes at a later stage (Photo B52).

Put the cartridge, boiler barrel and four bushes in the pickle for 10-15 minutes. Remove, drain and wash in cold clean water.

1) The cartridge now has to be fitted into the boiler barrel so that the firebox tubeplate having the three lower stay nuts protruding is fitted into the **top** of the boiler barrel which can be recognised by the greater distance between the machined end and the tapped bush holes. It needs to be pushed so that the upper two tapped holes in the boiler barrel fall approximately midway between the tube plates of the cartridge.

2) For total piece of mind, lightly coat both sides of the smokebox tubeplate that is protruding with flux.

3) Screw a 1/4-inch x 40ME protection plug into each of the bushes finger tight, to prevent any damage to the threads in the bush when heating.

PHOTO B52

Wire-wool plugs inserted into tubes helps prevent later damage when heating.

PHOTO B53

Heating to silver solder boiler bushes in place.

PHOTO B54

With the operation complete, the bushes are properly attached.

PHOTO B55

Look inside boiler to ensure equally smooth fillet around bush.

4) The two upper 3/8-inch x 32ME threaded holes should be fluxed making sure that there is some flux visible on the inside of the boiler barrel, before fluxing each threaded bush in turn and screwing into the boiler barrel.

5) Measure the protrusion of each bush and adjust to 5.5mm.

6) Press onto each threaded bush one of the silver solder rings made earlier, and flux around the bush, ring and immediate vicinity of the boiler barrel.

7) Lay the assembly on the hearth with one bush vertical. Heat the boiler barrel all around the vicinity of the bush but avoiding playing the flame directly onto the solder ring, until the water has boiled from the flux (Photo B53). Continue heating until the flux becomes transparent, the silver solder 'slumps' and then flows. The flame may now be directed at the bush whilst the quality of the fillet is confirmed. Remove the heat and using tongs move the second bush to the vertical position, before repeating the process (Photo B54).

8) When satisfied that both bush joints/fillets are formed remove the gas torch. Remove the protection plugs whilst still hot. You will now be able to confirm the quality of the fillet on the inside of the boiler barrel which should be at least as good as the one visible on the outside (Photo B55).

Allow the assembly to cool before carefully submerging in the pickle for about 20 minutes. Drain off. Rinse in cold clean water, brush to remove all residue using a toothbrush, nail brush or similar. **EIM**

NEXT MONTH...

Martin carries out the second stage of the silver soldering.

■ Parts 1 to 5 of this series appeared in the October 2018 to February 2019 issues of **EIM**. Digital back issues can be downloaded or printed versions ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by telephoning 01778 392484.

B53



B54



B55



23rd London Model Engineering Exhibition

John rounds up the first big event of the year, with plenty to see at Alexandra Palace.

BY JOHN ARROWSMITH

Alexandra Palace was again the venue for the 23rd London Model Engineering and Modelling Exhibition on 18th-20th January with the Great Hall embracing all that is good in the model engineering world. Attendances were slightly down but nevertheless at times the hall was extremely busy which is always a good sign.

Model engineering clubs involved with the exhibition showed the versatility of the hobby with a wide range of excellent models and features. It was also pleasing to see the number of club stands where some of the models were actually working. This does help visitors, many not serious model engineers, to understand how machines can be operated. This aspect is always a feature of continental shows and it is good to see this exhibition following suit.

The club stand competition is always keenly fought with some imaginative presentations being shown. The competition is judged by all the stand holders with no input from organisers or visitors. This year an amazing presentation by the Chelmsford SME (**Photo 1**) was awarded first prize for what was probably the largest club display I have seen at this exhibition. The club had a selection of working horizontal and vertical engines on a turntable (**Photo 2**) while the Garratt locomotive was an unusual prototype (**Photo 3**). On the very top of the stand a small up-and-down track was worked by a couple of locomotives while on one end a Meccano-built funicular railway was trundling up and down all day.

Golden Simplex

As this event coincided with the 50th anniversary of the introduction by Martin Evans of the 'Simplex' design of 5-inch gauge steam loco, the club recognised this by having 13 of the 15 examples in the club on show.

Second prize in the competition was awarded to the comprehensive display by the West London Meccano Society which included a very large model of the Eiffel Tower (**Photo 4**) – this was well lit with lots of small LED bulbs. The stand featured some complicated models, none more so



PHOTO 1:

The winner of the Club Shield was this amazing display by the Chelmsford Society.

PHOTO 2: The turntable on the Chelmsford stand housed a series of stationary engines, all working on compressed air.

All photos by John Arrowsmith unless stated.

than the working recreation of the folding bridge located on the Paddington Basin of the Grand Union Canal. The Midlands exhibition also had a prize-winning Meccano entry in the similar competition there – perhaps the basic idea of using the building system as a modelling material is beginning a resurgence?

In third place was the Maidstone Society which provided a number of well-made models to enjoy with a good selection of locomotive prototypes. It was difficult to decide

what to include, such was the variety on show, but a rare model was the 3½-inch gauge Princess Royal Pacific built by Harry Powell from Crewe works in 1936 (**Photo 05**). This engine looked in pristine condition despite its age and displayed some exemplary workmanship as would be expected from the builder. Some useful tooling such as a tailstock drill attachment complimented the loco models.

The organisers always try to bring something different to this exhibition which is not an easy undertaking, but





PHOTO 3: This 5-inch gauge Garratt was on the Chelmsford club stand.



PHOTO 4: A Meccano Eiffel Tower headed the West London display.

PHOTO 5: A pinnacle of loco building on the Maidstone stand – a 3 1/2-inch gauge Princess Royal Pacific built by Harry Powell.



PHOTO 6: The 10 1/4-inch gauge Fowler Dock tank on the 10 1/4" gauge Society stand.

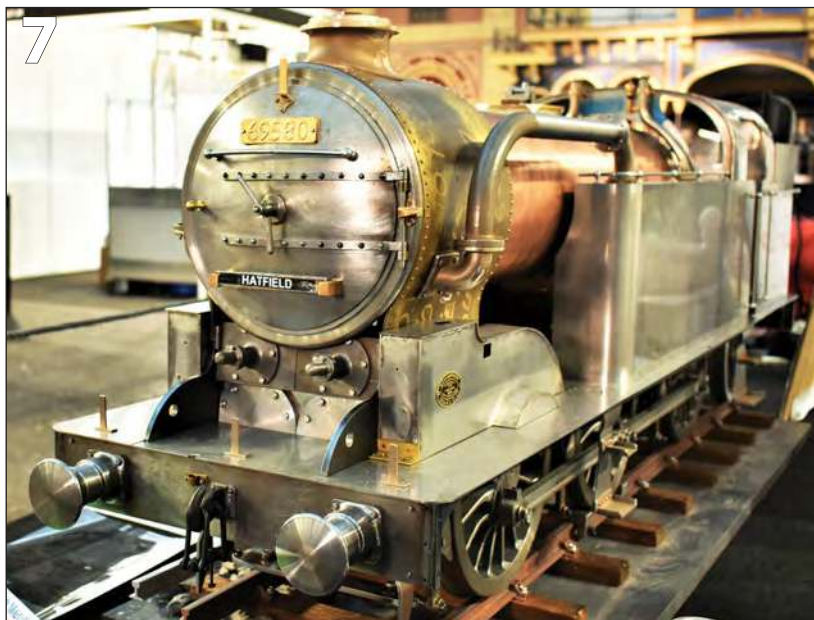


PHOTO 7: A magnificent LNER N2 0-6-2 being built by a member of the 7 1/4-inch gauge Society.

PHOTO 8: Tank vent pipes on the LNER N2 locomotive.



this year achieved by the inclusion of the Ministry of Steam Punk display. (Photo 9). Critics will say that this is not model engineering and I can understand their view, but the fact that every exhibit in the display had been made and finished by members of the group was relevant to the concept of the exhibition.

The basic objective (I hope I have got this right), is to try and combine details, events and materials of the past and make them into objects and features that replicate history in all its various forms, whilst looking to the future. The general public enjoyed the display, especially youngsters as there were objects and artefacts from both film and television, such as Dr Who's 'Tardis', there to see and touch. This last detail is important, visitors able to realise that everything was made from simple everyday materials.

In complete contrast the 10 1/4-inch Gauge Society provided two models and a wagon chassis, visitors able to get up close and see how these large



engines are constructed. The 0-6-0 tank loco, in the style of a Fowler Dock Tank, captured the outline of these little engines very well (Photo 6) and the Hymek outline diesel loco had been repainted for the exhibition.

The 7¼-inch Gauge Society featured a superb 0-6-2 LNER N2 (Photo 7) under construction for the last three years. Some excellent dummy condensing pipework really sets the profile up to that of the original. The oval-shaped tank vent pipes in front of the cab were works of art in their own right (Photo 8).

Star of the Northolt MRC stand was the 7¼-inch gauge American 'Big Boy' being built by Alan Antiss (Photo 11). The model contains some excellent details and combined with the works drawing showing the details, visitors could see clearly what a wonderful piece of work this loco will be when complete.

Potato power

The Chingford & District MEC stand featured a good working selection which included a hot-air engine made from a well-known crisp manufacturer's cylindrical cartons. This amused many people as it was so simple yet effective (Photo 12). An excellent example of an Adams 4-4-2 tank engine also graced the display.

A star of the Sussex Miniature Locomotive Society stand was the little 5-inch gauge Barclay tank locomotive 'Dougal' currently being



PHOTO 9:

Star Wars droid R2D2, Steampunked!
Photo: Andrew Charman

PHOTO 10:

The Sussex MLS display included a goods train headed by a 5-inch gauge Fowler 0-6-0.

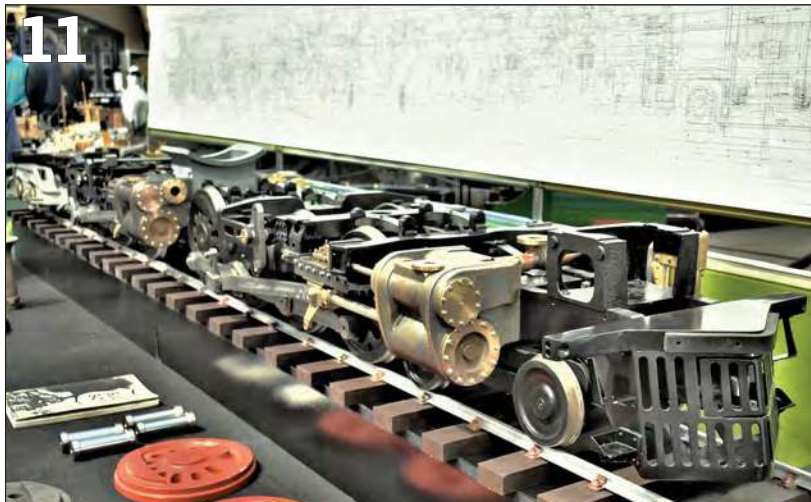


PHOTO 11:

The part-built 7¼-inch gauge 'Big Boy' on the Northolt MRC stand.

PHOTO 12:

Hot air – burnt to a crisp?

PHOTO 13:

Starting them young on the SMEE stand.

PHOTO 14:

Excellent idea – a dedicated stand of work by young engineers.





serialised in **EIM**. With builder Andrew Strongitharm in attendance it provided plenty of interest. A well-built goods train headed by an LMS Jinty 0-6-0 (**Photo 10**) and a 5-inch gauge 9F under construction together with a couple of test rigs for fittings and castings made for a well balanced display.

Young to the fore

EIM has always supported a good Young Engineers section and this year for the first time a separate stand was dedicated to work by young people. The idea was put to the organisers by Pat Hendra from the Eastleigh Model Boat Club – this organisation has produced some superb examples of what young people can achieve when they are given the opportunity. With support from the Blackheath Model Power Boat club, the new Branch Line Learning Centre at the Sussex Miniature Locomotive Society and the Hereford SME, a display of work, models and tools was presented for visitors to enjoy (**Photo 14**).

It certainly created a great deal of interest, but the question is whether all those interested enquiries will actually result in other clubs passing on their skills and knowledge to young people and older ones in their area. I hope next year other clubs in

PHOTO 15:

This Fowler traction engine was on the St Albans MES stand.

PHOTO 16:

A 0-1-inch Braille micrometer shown on the SMEE stand.

PHOTO 17:

This superb Walschaerts valve gear demonstration rig was on the Branch Line Learning Centre display.



the South East will join this Young Engineers display and hopefully create even more interest.

An interesting display by the St Albans & District MES provided a varied selection of models from excellent boats to a scratch built radio-control digger loader machine operated on a regular basis by builder Godfrey Greaves. A fine RAF Fire Tender built by Rob Braincourt along with the Clayton Steam Wagon and the 1-inch scale Fowler BB1 ploughing engine (**Photo 15**) were representative of the range of models on show.

A well-made bridge scene was the focal point of the Harlington Locomotive Society display featuring a short goods train hauled by a GWR small Prairie. On the other end of the scene a Westernised Simplex 0-6-0 (**Photo 22**) caught the eye and very authentic it looked as at first glance it appeared to be a standard Pannier, but looks can be deceiving!

The Welwyn Garden City SME included a varied range of larger modern ships, boats and some fine stationary engines – a 5-inch gauge saddle tank was particularly well finished and presented.

The presentation from the SMEE included the usual comprehensive selection of both archive and new models along with a presentation of training day programmes. A Braille one-inch micrometer was a very novel piece of equipment which enabled blind people to work in the inspection department of a company to an accuracy of a tenth of a thousandth of an inch (**Photo 16**).

The opportunity to try operating a

centre lathe was very popular again with a wide variety of visitors having a go, from younger children (**Photo 13**) to adults. One of the latter was Bethany Kamholtz from the American Railroad Showcase, who with her husband covers all aspects of railroading as they call it, both in the States and in UK.

A very well-made and presented model of a Mississippi paddle steamer was the focal point of the Harrow & Wembley SME stand (**Photo 21**) accompanied by models working on air including a traction engine. A nice little 0-4-0 GER Tank loco added to the overall display.

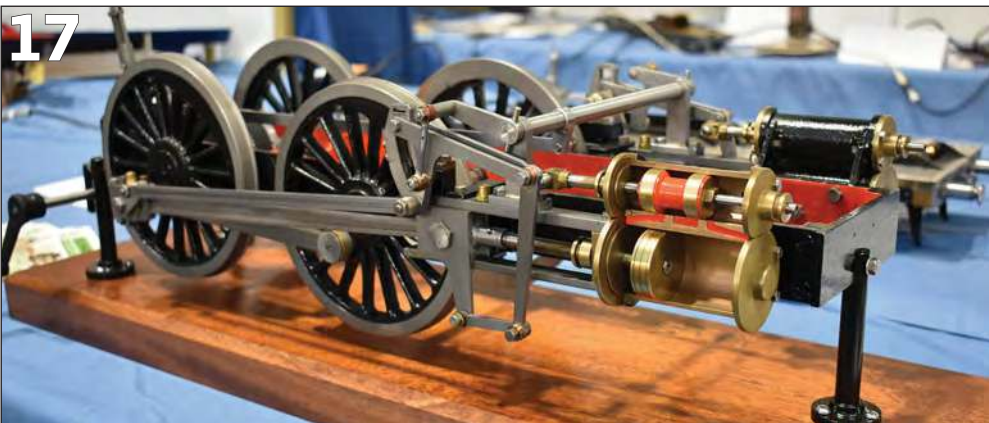
The Gauge 3 Society displayed a selection of beautifully made stock showing the detail and finish these excellent models provide. Further along the Hanwell and District Model Society had a large stand showing a wide range of models and members' interests. Boats, sailing ships and road vehicles combined to make an interesting display.

Peter Partington's rear-axle assembly for a Foden Steam lorry was the centrepiece of the Ickenham & District SME's varied display (**Photo 022**) – it showed some superb workmanship and detail. A chassis for an LSWR B4 0-4-0 Dock Shunter under construction by Tony Caudrey was a good addition to the stand.

On the Romford MEC display a 9-cylinder radial engine under construction by Steve Thompson was showing some excellent workmanship and will be a super model when complete (**Photo 18**). A 7¼-inch gauge De Winton battery locomotive under construction by Dave Budd will be another fine model when finished.

Operating interest

Regular participants in this exhibition are the Gauge 1 MRA with the large operating Invicta track layout. This is always popular as visitors can see a wide variety of locomotives from all the old railway companies together with some excellent rolling stock. An interesting addition was the provision of a hand-held controller that allowed spectators a short run with a steam locomotive on a siding so that main line operations were not affected.





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'Indian Hills' is the name of the layout presented by the East Surrey 16mm Group and inspired by the Darjeeling Himalayan Railway with Class B and Garratt locos hauling lots of colourful stock through scenery keeping visitors entertained. Meanwhile the Buckinghamshire Garden Railway had its Whiteleaf Light Railway G-Scale layout. This has quite a low baseboard and enables the younger children to enjoy the sights and sound of the trains.

Operating railways always attract attention and the Polly Owners Group running a portable track in the hall was kept very busy during the show. As part of its static display the group had a very nice chassis on show which is being built from a kit by a very knowledgeable lady who was keen to show off her mechanical skills.

By sea, air and street

This exhibition always attracts a good attendance from expert ship and boat builders and again this year the Surface Warship Association displayed some superb models covering a wide variety of prototypes and all of excellent workmanship.

The Moorhen Model Boat Club also had a good selection of fine models on show combined with a selection of radio-control road vehicles of various types. Alongside, the display by the Victoria Model Steam Boat Club reflected the wide interests within the club with a mixed range of vessels from the very fast flash-steam hydroplanes to the slower coaster ships of yesteryear.

The Model Hydroplane Club of Great Britain provided a typical range of these very fast craft which are still a popular way of enjoying a skilled hobby. Meanwhile the British Model Flying Association provided a varied programme of flying events within its zone (Photo 20) and also a hands-on demonstration cubicle where anyone could try their hand at flying model aircraft, and the self-built table where again anyone could try building a simple model. They entertained a great many people.

Adjacent to the flying zone the Tamiya Trucking group displayed many types of radio-control road

PHOTO 18:

Part of a 9-cylinder radial engine being built by Romford MEC's Steve Thompson.

PHOTO 19:

Displayed on the Ickenham stand was this fine Foden axle built by Peter Partington.

PHOTO 20:

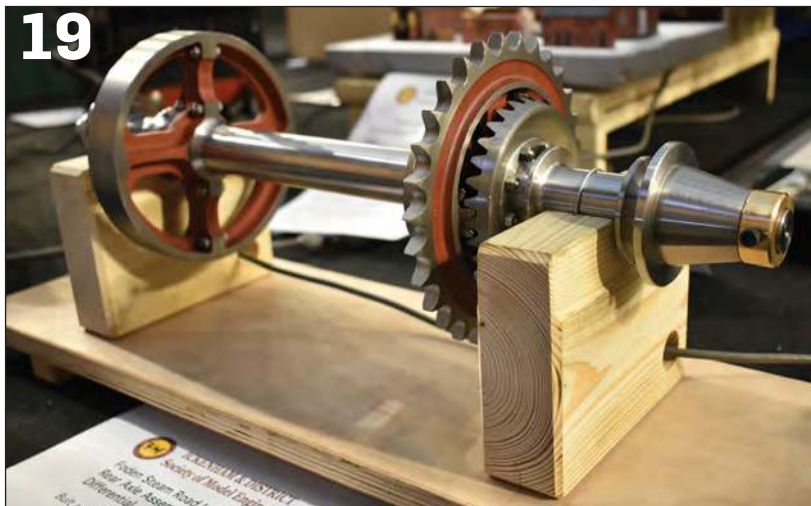
"Now stay..." Precision skills in the model flying zone.

PHOTO 21:

A superb Mississippi paddle steamer shown by the Harrow and Wembley club.

PHOTO 22:

It fooled our reporter! The Westernised Simplex on the Harlington club stand.



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vehicles both static and operating. The group provided an active road and handling area to show how these impressive vehicles can be moved around a comparatively small area.

Both National Federations, Northern and Southern, had displays of what they can offer model engineering clubs, with the promotion of awards for young engineers, information leaflets and boiler code books along with representative models adding interest.

In concluding these notes I can only say a very big thank on behalf of the organisers for everyone who took part, without you of course there would be no show. Space precludes a detail of everyone but the plastic modellers, the preservation displays and the hands-on stands were all good

displays which added to the overall exhibition. I hope to see you all again next year. **EIM**

■ More photos on the club news pages.



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Building a large-scale Fowler Steam Lorry

Martin continues the chassis of his unusual 7-inch scale project, turning to the rear axle.

BY MARTIN JOHNSON

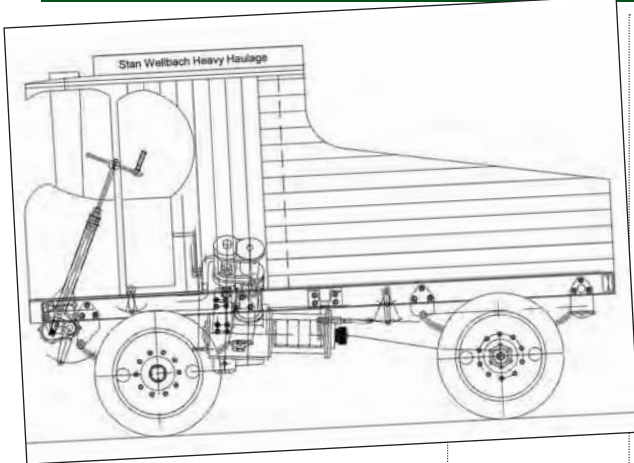
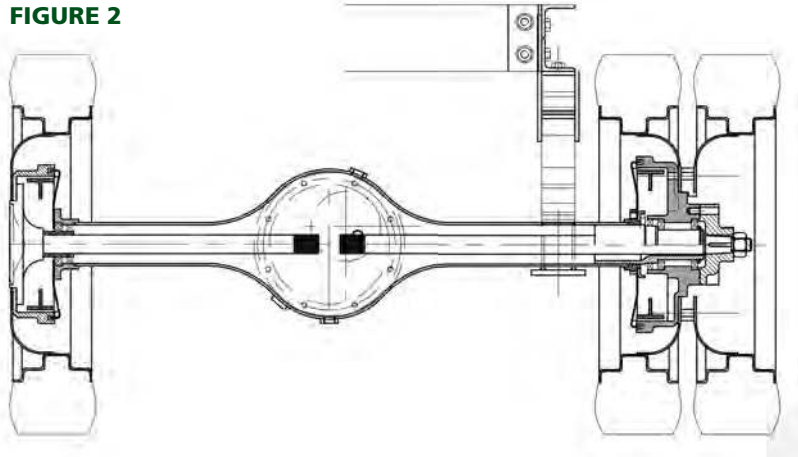


FIGURE 2



By comparison with the front axle, the back one is a simple job based on a Suzuki Jimny rear axle. However, the Suzuki unit, like most car axles, is a 'semi-floating axle' whereas a typical lorry axle is 'fully floating'. The left-hand side of **Figure 2** shows the Suzuki arrangement, while the right-hand side shows the fully floating arrangement after modification. The track was also reduced from that of the Suzuki unit.

The original Fowler axle was an overdriven worm and wheel unit – that is a worm mounted on top of the axle drove a worm wheel as opposed to the usual hypoid bevel gears of a modern axle. I considered that copying the overdriven worm and wheel arrangement was just too difficult, so the differential, crown and pinion assembly was unchanged, apart from being turned upside down to approximate the high drive shaft position. This reverses the direction of rotation of the drive shaft, which could be a problem with an internal combustion engine drive but was easy to accommodate with a steam engine.

Photo 23 shows the axle obtained from the scrapyard with the remains of its swinging-arm suspension, which all needed removing with a cutting disc and oxy-propane along with a lot of Aberdeenshire mud and salt. **Photo 24** shows the axle case after cleaning up and chopping off the unrequired parts, plugging off oil vents and drains and providing new bosses for replacements.

The first items in the rebuild were new spring seatings for the leaf springs. These have to go on at a four-degree angle, to match the

All photos and diagrams in this feature by Martin Johnson – see text for captions

four-degree inclination of the engine unit – both input and output shafts must be at the same angle to avoid destructive torsional vibration. The four-degree inclination of both shafts also kept the angle over which the universal joints work to around seven degrees, which should be acceptable for a slow-revving shaft. This was also the reason why the axle was inverted, since this brought the axle input shaft and gearbox output shaft into closer alignment.

Photo 25 shows the spring seat

has been tacked in position, and the bearing seat is being aligned using a half shaft from another Suzuki, which is located in the differential unit. The inner bore of the bearing seat is a sliding fit on the half shaft at this stage, to ensure axial alignment; the half shaft will be turned down later. The bearing seat includes a polished seat for the oil seal to run on and close tolerance diameters to take the wheel bearings – hence the tin can retained with a jubilee clip that will keep weld spatter off these surfaces





during the welding operation.

Finally the brake backplate flange must also be fitted at a specified angle, so that the brake hoses and handbrake cable have reasonable lines and the brake adjuster and inspection holes can be accessed – all of which was worked out on the CAD and with a wooden mock up. **Photo 26** shows how the angle was checked before tack up. Full welds were completed on the axle case and then it was painted to undercoat stage.

The half shafts needed modifying to take suitable drive flanges, but the inboard splines which engaged in the differential were left as they were. The main problem was that the Suzuki half shafts were hard – probably an EN24 or EN19-type steel in the toughened condition. One half shaft (from another vehicle) needed turning down along most of its length, which was done with a carbide tool running fast at high feed rate with a small cut. This approach takes the heat away with the chip and leaves a fine finish. However, there was also a taper, a keyway and a thread to machine, so the outboard ends were annealed. One shaft stayed reasonably straight, but the other warped but I was able to machine out the warp. There is not too much to say about this operation, except getting the half shaft length correct took quite a lot of measuring and double checking.

Photo 27 shows the modified end of both half shafts being assembled to the drive flanges. Since these parts are unlikely to need dismantling, everything was coated with Loctite. The form of the drive flange castings follows that used by Fowler.

Rear brakes

The rear brakes are Volkswagen Beetle units with drums generally as described for the front axle, but different bearing sizes. Front brake backplates are easy to obtain, since many Beetle owners upgrade to front disc brakes; the basic pressing is the same for both front and back, so I modified a couple of front backplates to rear specification by cutting the required holes for handbrake cable entry. Once again, the internet was my

source of information on what size and where the holes should be cut.

Photo 28 shows the rear axle with brakes assembled, before the brake drum complete with bearings and oil seal is slid on to the bearing seat to be retained by a large circlip. Note the tin-can protection for the bearing seat still in use! You can also see that the input shaft is tilted up by some four degrees and that the handbrake cable has yet to be fitted.

As discussed earlier, the wheels really needed a little more 'dish' on them, but that would have required breaking and re-making at least 28 welds on quite thin pressings, so I decided against that route. As a consequence, I needed spacers between the rear wheels to prevent the tyres rubbing. These were made from castings taken from a simple 'flat-back' pattern, and machined using the brake drum holding fixture and drilling jig previously described.

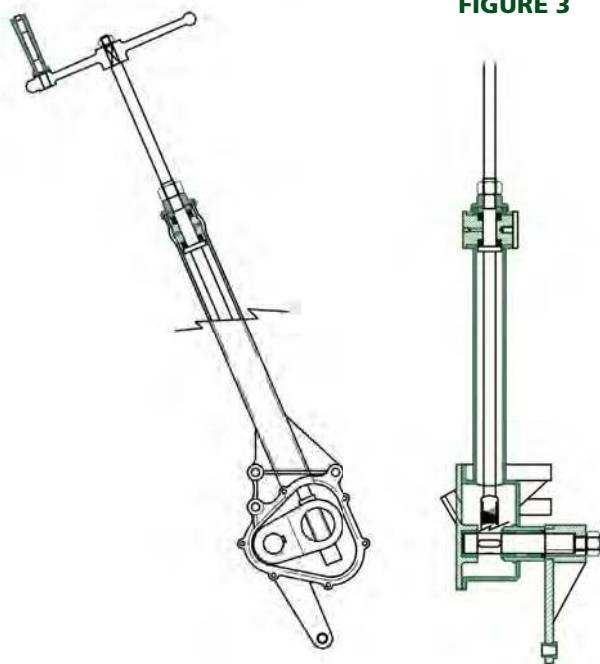
Was all the work on wheels and axles worthwhile? Well, you can decide from **Photo 29**, showing what most people will see.

Steering Box

The steering box is a very close copy of the Fowler unit. The preserved Fowler lorry presently carries a non-original Marles steering box. The original Fowler unit was a prominent lump on the vehicle offside and was a 'screw and nut' unit housed in an oil-filled casing and for the most part I have simply scaled the Fowler drawings down. My assembly drawing of the box is shown in **Figure 3**, which shows the working principle of a screw



FIGURE 3



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and nut, the screw being supported in trunnion bearings.

Work commenced with the casing, which is a complex welded fabrication, the early stages of which are shown in **Photo 30**. From far left, this shows the casing body which is made of three parts each bent to profile. Next is the flange which is a laser-cut blank, next right is the casing back from another laser-cut blank and a turned bush to form the output shaft housing. The construction method relies on the accuracy of laser-cut parts to produce the geometry of the finished article. This is particularly so with the profile at the top of the photo, which is the webs to strengthen the steering column; the part will ensure that the steering column will be assembled at the correct angle to the casing.

Photo 31 shows the next stage in the fabrication process where the web section for the steering box tube was bolted through spacer columns and the lugs on the front flange during welding – thus ensuring that the webs are correctly located in relation to the box and will locate the steering tube when it is dropped into place. The metal at far right of the photo bridging between the two webs will be sawn out once it has completed its purpose of preventing undue distortion during welding.

Photo 32 shows the complete assembly being set up for welding while clamped to a piece of 1-inch plate. It will be seen how the webs of the box ensure the steering tube follows the correct 'bearing', while the scribing block is being used to ensure

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"The original Fowler unit was a prominent lump on the vehicle offside and was a 'screw and nut' unit housed in an oil-filled casing..."

the 'azimuth' is correct as well. In fact after welding it was found that the assembly had distorted and the azimuth of the tube was wrong. This was corrected by heating the tube on one side to near red heat using the oxy-propane torch and allowing the assembly to cool, which brought the tube into correct alignment.

The completed housing was machined, starting on the bolting face for the cover plate to provide a reference surface. **Photo 33** shows this in progress, using a flycutter to clean up the flange for the cover plate. The fabrication had to be jacked and adjusted to make best use of the fabrication – just as a casting has to be 'juggled' to make best use of the metal.

Once the flange was trued up, the assembly was flipped over and clamped down on the flange face for boring the output shaft housing and the trunnion housing – thus ensuring these were at right angles to the flange face. The three feet were also trued up so they sit on the chassis firmly, which completed the casing apart from fitting the cover plate.

Reversible steering

I designed the screw and nut from scratch; a steering box should be reversible and hence the helix angle of the screw needs to be between 10 to 25 degrees for reversibility and ease of use, which means the lead must be at least 1/2-inch on a 1-inch diameter screw, and for strength needs to be a multiple-start screw. I opted for 0.6-inch lead with three starts and such a screw cannot really be cut on an ordinary lathe, so I milled it.

Photos 34 and **Photo 35** show how the milling operation was done. This required a new leadscrew support to be made along with a gearing banjo and gear studs to be manufactured. The gears are standard Myford items purchased on the internet. The steering screw only just clears the Tom Senior knuckle head when tilted over to the thread helix angle of 12 degrees,

32



33





so an extended cutter arbour also had to be made, which is seen in Photo 35.

Milling questions

In fact before getting to cut the real threads, I undertook a lengthy investigation to find out how to mill it! I started out attempting to cut a square thread with a $\frac{3}{32}$ -inch end mill, but the finish was appalling due to cutter deflection as shown in **Photo 36**. If I had been able to run the cutter much faster, it might have been better but the Tom Senior was at top speed for the trial, and I did not want to make a dedicated high-speed spindle.

My next trial was with a slitting saw applied at the helix angle of the screw. This gave a better finish but with quite a bit of rubbing at one side of the cutter due to the helix action of the thread, leading to heating of the work. I deduced that if I changed the thread form to Acme, then this would not be a problem.

My next step was to see what module or DP gear cutter might be a good approximation to a 0.6-inch pitch three-start Acme screw. I calculated that 16 DP was close and purchased a No. 1 (135 tooth to rack) cutter. This gave much better surface finish, but I found that the gaps between the threads were too narrow. This is important because the nut would be cast in whitemetal, which is relatively weak, and so the threads in the nut needed to be the correct width for strength.

In order to broaden the gaps and narrow the threads, I built a tool and cutter grinder – just six months work there – to modify the cutter by taking metal from the cutter tips, which had the effect of widening the flank. This worked, but then the flanks of the thread were too curved; a No. 1 cutter is correct geometry for a 135-tooth



gear, which is significantly different to the rack form of an Acme thread. Fortunately, my T & C grinder was also able to modify the side flanks of the cutter teeth into a rack form and give it the correct width.

On top of that, I made other ventures into dead ends like wrongly indexing the three start threads and left-hand instead of right-hand lead! **Photo 37** shows the results of my labours – at last a correct thread form with reasonable finish!

The nut was to be cast in whitemetal in a bronze outer. A length of oversize thread was cut on a short mandrel to cast the nut, so that the casting would have a controlled clearance onto the actual screw. An Acme screw should have a nominal radial clearance on the tips of 0.25mm or 10 thou; I settled for a 25.4mm outside diameter on the casting mandrel and 25.00mm on the screw, which has worked well.

Whitemetal casting

There was also some development work to do on whitemetal casting, which was a job I had not tackled before. There is some good guidance on the internet, but I found some problems in ensuring a well-tinned housing which is essential for the whitemetal to bond properly. Temperature control is also difficult because the tinned housing should not be overheated, otherwise the tinning will burn, but it must not be too cold either otherwise the whitemetal will not mould to the mandrel very well. In addition, the molten whitemetal must not be overheated and must be up to temperature at the same time as the housing. I found an infra-red thermometer was quite a help in this juggling act.

I also cast some trial nuts using lead to learn the technique before working with (rather expensive) whitemetal. This threw up other problems with sealing the screwed mandrel as it passed through the bronze outer, which was finally achieved with Gun Gum, the well known exhaust repair paste. **Photo 38**



shows the finished nut – as a matter of interest some Rolls Royce cars use whitemetal steering nuts.

After completing the screw and nut, the remainder of the steering box is straightforward engineering. **Photo 39** shows the lower section of the steering box assembled. The output shaft is supported in three oilite bushes with an oil seal to retain the oil. The shaft is of EN8 steel, simple turning, but with quite tight tolerances and two keyways.

The internal steering arm is machined from a 60mm thick flame-cut blank, while the outer drop arm is a welded fabrication from turned parts and a laser cut blank. **Photo 40** shows the upper end of the steering screw with (from left) a thrust bearing (in packaging), the trunnion and retainer, another thrust bearing, retaining nut with rain shield and locknut. The steering wheel will fit on ►



39



the square to the right of the photo.

Finally, **Photo 41** shows the finished box with steering wheel. The steering wheel is an aluminium alloy casting which was cast from a pattern machined from perspex. Completing the steering box took nearly a year of

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work about half of which was construction of the tool and cutter grinder and other tooling. **EIM**

■ Previous parts of this project appeared in the September and October 2018 and February 2019

editions of **EIM**. The series continues next month with further features as the build progresses. You can also follow construction online at: www.flickr.com/photos/140734312@N06/sets/72157669955074511. The author can be contacted via the editor.

WHAT WENT WRONG?

A hole lot of frustration...

Harry highlights a bit of time-saving that proves to be exactly the opposite...

BY HARRY BILLMORE

I was in the workshop of a fellow model engineer recently and he told me of an interesting error that had cropped up while he was machining a series of bobbins to fit onto a 7¼-inch gauge slate wagon. The error was compounded by not noticing it early enough – for these bobbins it didn't matter, however for more accurate components, it could prove critical.

The problem was caused by the hole being drilled on the lathe using a normal twist drill. The first time the drill was employed it went into a pilot hole previously drilled using a centre drill, so at the start of the job it was in the centre.

The hole was drilled down the length of the bar slightly deeper than the overall length of the bobbin. Once the outside had been machined and the finished bobbin parted off, the bar was drawn out of the chuck and the hole that was left over from the previous bobbin used to locate the end of the drill to start the next hole. After five or six bobbins were made the situation in the photos arose, the hole appearing decidedly eccentric.

This is caused by the nature of twist drills – the centre chisel section relative to the work does not cut, it is forced through the material. It is this property, combined with slight changes in the metallurgy of the steel, that causes drills to wander. This is often not helped by poor grinding of the drill with different-length cutting faces on each side of the chisel section.

In this case the problem became

particularly apparent by the multiplication of errors, by not facing the surface and using the centre drill to re-centre the hole between each bobbin. **EIM**



Celebrating two decades in the forest

Model engineering supplier Forest Classics has plenty to celebrate heading into a new year, 2019 marking the 20th year the Forest of Dean-based business has been trading.

Established in 1999 and initially stocking Mamod equipment, Forest Classics has since become the UK distributor for the well-known Willesco range of steam models, traction and stationary engines, and today describes itself as the UK's leading toy steam dealer.

But as the firm's Phil Handcock described to *EIM* when we recently called into the impressively stocked unit in Coleford, Forest Classics also has a great deal to offer larger-scale model engineers.

Dotted amongst the many Mamod and Willesco engines on the shelves were traction engines of 1-inch scale and larger, while Phil also pointed out the boxes of very large scale castings on the floor, just delivered for a customer's project. Other tempting boxes included Stirling engines, the impressive Red Wing range available as either kits of castings or fully machined, and accessories down to such basics as steam oil.

So in 20 years what has changed in the business of small-scale steam? To Phil the big change is definitely the rise of the internet.



"We used to have to attend lots of shows each year," he said. "Now the Internet does all of our promotion for us. "We had a new website last year, customers are able to see our entire range and order direct."

After 20 years Mike does not anticipate his busy life getting any less busy any time soon. We enjoyed our visit, especially as one can combine calling in with checking out the Dean Forest steam railway, two miles up the road! Forest Classics; www.forest-classics.co.uk

End of line for Rushden cavalcade

Readers of *EIM* who have previously enjoyed either watching or taking part in the annual cavalcade run by the Rushden Historical Transport Society will know that the Northamptonshire event fell victim to bad weather last year.

Now the Society has announced that after 39 years the event, which at its peak was attracting 1200-plus vehicles including several full-size and miniature traction engines and 25,000 visitors, will no longer take place in its traditional format.

"Due to ever increasing costs, new health and safety legislation, the staffing required, the challenge every year of the weather early in the year and the financial risks of running the event make this an unviable proposition for the future, therefore the trustees have decided to offer alternative events," a statement from the RHTS said.

The RHTS operates a transport museum at the former Midland Railway station on the Higham Ferrers branch line, closed in 1969.

LETTERS

Grate question on the Claughton build

Enjoyable for the tech detail

'Thumbs Up' to you and Mike Wheelwright for the series on the building of a L&NWR Claughton – 'A



Distinguished Gentleman' (*EIM*, June-October 2018). Mike told us of his attraction to this elegant black prototype, gave us the story of the prototype's design and, most importantly, related his modern-day design criteria for good performance; in other words valve travel/lap, throttle design, tube/flue free gas area, subtleties of the rocker-lever mechanism for driving the inside valves, and more.

His inclusion of an 'arrangement' drawing of the exhaust system (said by David Wardale to be the "very heart of the steam locomotive") is rare and much appreciated; most construction articles give drawings of the components but not the assembled key dimensions.

In short, I was both entertained by Mike's recounting of his working-out of all the particulars for his "pride and joy" and I learned a lot too. Thanks for the series!

Jim Keith, Cincinnati, Ohio

PS. Of course, there is always one thing that a reader thinks is missing. In this case it is

LEFT: Mike and his Claughton. A reader has just one question on the grate.

the grate area (or its dimensions). This would allow determination of the chimney-throat/grate-area ratio, one measure of the relative exhaust system size. Thank you.

Mike Wheelwright replies: It's nice to hear that somebody found the design bits of interest. The grate area of the model is 24.5 square inches, a bit short on a true scale 35 sq in due to a slight shortening of the firebox (for an easier fit) and an oversize wrapper thickness with improved water spaces.

The engine works quite happily at about 0.3 drawbar brake horsepower and the blast-pipe nozzle area is two per cent of total piston area, my standard arrangement for all engines. This is a bit more than most models have but significantly less than the three per cent or more found on well draughted full-size modern locomotives.

Model engineering query to have answered or a point to make to your fellow readers? Email andrew.charman@warnersgroup.co.uk or write to 12 Maes Gwyn, Llanfair Caereinion, Powys, SY21 0BD.

Kicking off the year in London

Shows are to the fore in this month's round-up of the club scene.

COMPILED BY ANDREW CHARMAN

It occurred to your editor, while perusing the stands of the London Model Engineering Exhibition in January, that such shows provide an excellent opportunity for clubs to get together, show off the work of their members and 'compare notes.'

All of which makes it the more disappointing that our regular correspondents tell us that the club stands at the big shows are generally declining in number and in size. No doubt the reasons for such decline will mainly be costs and the major work and responsibility that goes into organising a presence at a show, but we would be interested to hear from the clubs as to why exhibiting at a show no longer holds the appeal it once did.

And it is major work, especially if a club goes the extra mile, as was evident in London, and why we are illustrating these pages with some more photos that were squeezed out of John Arrowsmith's report.

There was no finer example of going the extra mile than provided by the **Chelmsford SME**. Your editor kept coming back to this stand, quite the largest, definitely the tallest, he had seen for some time.

It had also clearly been carefully planned – the backscene was designed as a shed front and displayed the many examples of the Martin Evans Simplex celebrating the 50th anniversary of the design. At one end a funicular operated from bottom to top, much to the delight of the many young visitors, and at the very top a G-scale diesel was just visible traversing back and forth at a dizzying height.

Working attraction

To the fore a selection of stationary engines were mounted on a turntable so they could all be seen, and all connected to an air compressor so they worked. The attention to detail was exemplary and the club a deserved winner of the best stand in the show.

Mind you others made plenty of effort too. I particularly liked the stand of the **Maidstone ME** which unwittingly supplied this issue's cover photo with an engine shed diorama, but featuring a 5-inch gauge loco. And the **Harlington Locomotive Society** also clearly thought long and hard about its stand, basing the entire



ABOVE: A Liverpool & Manchester 'Lion', several Simplexes – Chelmsford pulled out all the stops.

BELOW: The Maidstone display was equally as commendable.

set-up around a bridge scene. Plaudits are due to all.

So we like our shows on **EIM**, and of course there are more to come. If you are reading this issue straight after publication you are still in time to get to the Manchester show that takes place on 23rd-24th February. Details are on the website at www.mmex.co.uk and apparently on the door entrance prices are just £7, with accompanied children free – a cheap day out!

The less well-known shows also

hold a lot of appeal and one that is popular is the Salisbury Hobbies and Model Exhibition. This year's show on 23rd-24th March is the ninth and will be in its traditional location of Michael Herbert hall, South Street, Wilton, Near Salisbury. SP2 0JS.

Pete Parrish of the organising committee tells us that there will be a wide range of high-standard model displays stretching across traction engines, locomotives, ships, fairground equipment and much more. Many of the exhibits will be



working, including some in steam outside while four-full-sized traction engines will also be present.

All monies raised from the show go to a good cause, the stars appeal for Salisbury District hospital. Further information is available by calling 01980 610346 or by email to p.parrish324@btinternet.com.

Away from the shows most clubs are deep into their winter maintenance programmes, though as our pleasingly full diary relates on the next pages, some are running trains even at this time of year for the more hardy visitors.

New among the many newsletters we receive at the office (all of which are welcome, keep them coming!) is that of the **York City & District SME**. Rail travellers perhaps heading to or from the National Railway Museum will likely have tantalisingly glimpsed the club's track alongside the East coast main line south of York station.

Effort rewarded

Perusing the York newsletter your editor was greatly taken by the presentation of the 'Wallace & Gromit' award, which goes each year to a club member adjudged to have contributed the most to the Wednesday working groups. The winner this year was member Robert Ruston (a good railway name!) who resurrected the ground-level sidings on the club track. There are members who quietly get on with contributing a lot in every club, so it's good to see such efforts recognised.

Elsewhere in the issue volunteers are being sought for the club's stand at the Doncaster show on 10th-12th May (another one to look forward to). "Your society usually puts on one of the best, if not THE best, club displays at the Northern Model Engineering & Modelling Exhibition," it reads – brave words, and perhaps a challenge to others?

Staying up north and reading *Leeds Lines*, the latest edition of the **Leeds SMEE** newsletter, certainly pours cold water on the claim that model engineering is a declining hobby. A running session held on Boxing Day was so successful that club chairman Jack Salter comments that it was more like an August rally, with a lot of locos and plenty of people to enjoy them.

Similarly the club's first members' night of the year proved, in Jack's words, "exceptional." Apparently in past years it's been difficult to persuade members to take part in the 'Current Projects Night', but not this time. "Numbers willing to present, the without exception high quality presentations and the level of intelligent questions from fellow



ABOVE: How to impress the visitors – various stages of loco building displayed on the Maidstone stand at the Ally Pally show.

BELOW: The Harlington Locomotive Society took a bridge as its central theme.

Photos: Andrew Charman and John Arrowsmith

members meant I had to work hard to ensure we finished at a reasonable hour," said Jack.

Projects described apparently ranged from a first 5-inch gauge loco to a magnificent test boiler, an automated railway for a shop window display, a high-capacity hand pump and the conversion of a rolling road to a rotating loco stand. Sounds like a lot of fun was had by all.

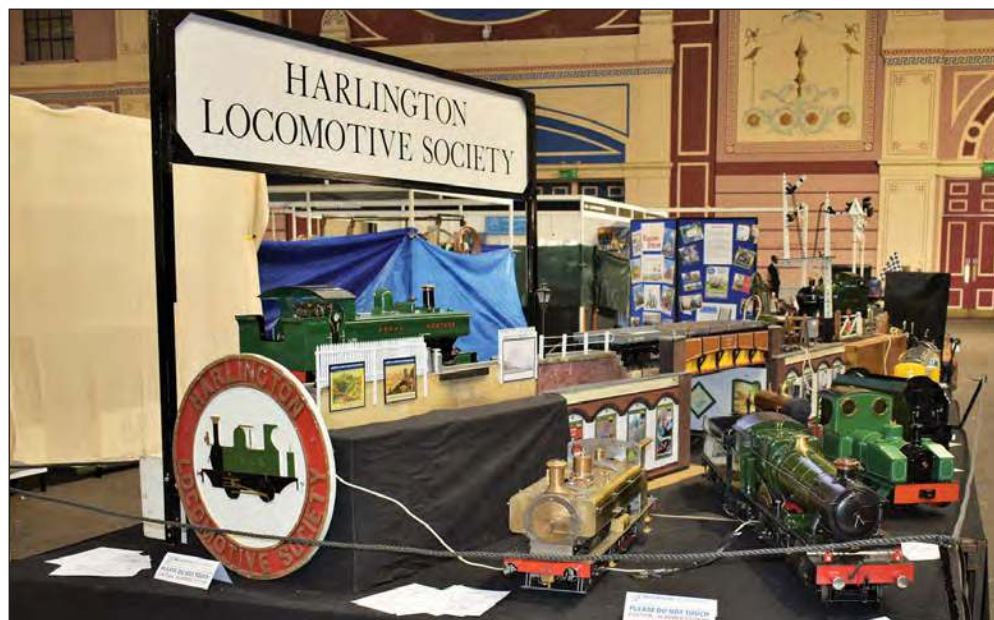
Which reminds me – if your club has a very successful evening or event, while not send in a picture or two from it? We always struggle to find the pictures for these pages – some clubs don't mind us extracting them from their magazines but it is always better to have some proper pictures to use.

Heading south, the latest edition of the **St Albans ME Gazette**

announces the launch of the club's new website, and it's well worth a look. When this was written the bright blue homepage was dominated by a time-lapse video of visitors admiring the club's stand at Alexandra Palace, while further investigation reveals that the site is rich in content, including the essential calendar, a for sale page and a number of interesting articles on model engineering subjects which members are being encouraged to add to. The website is at <http://stalbansmes.com>.

Winter demand

The latest email newsletter from the **Rugby MES** reveals that the club is as busy as ever, even in the depths of winter. The club ended the 2018 season just before Christmas with





ABOVE: On the new St. Albans website, a video showing just how busy was the club's stand at the London show.

BELOW: Rain? What rain? Less than pleasant weather at the last Rugby weekend of 2018 at least created some good steam effects! Photo: *Rugby MES*

themed running for the public, and despite inclement weather with rather a lot of rain plenty of people turned out and had a very good time.

The club was grateful for work carried out in November that improved the quality of the parking field and lessened the likelihood of visiting cars getting stuck!

Meanwhile Rugby has announced its calendar of major themed weekends in 2019. First will be the two-day open weekend on 25th-26th May during which there will be a grand opening ceremony for the new station. The popular Narrow Gauge Rally will take place this year on 13th-14th July and a 'Big Four Weekend' for owners of Southern, Great Western, London North Eastern and London, Midland & Scottish locomotives will be held on 10th-11th August.

That's all for this month, our club news pages squeezed by a very busy diary – a good thing! Let's see some pictures from your club's event in future editions – the address is on page 3... **EIM**



And finally...

The editor spotted this somewhat odd mounting of an anvil in a former railway workshop while on his trip to Taiwan before Christmas.

He wasn't able to establish just why it was mounted this way – was it as simple as too soft a floor?

Anyway, we are inviting readers to offer suitable suggestions – the funniest might appear on these pages so get thinking!



MARCH DIARY

EVERY SUNDAY

(Weather permitting)

Bournemouth SME public running, Littledown Pk, BH7 7DX, 11am-3.30pm

Canterbury SME (NZ) Public running from 1pm at Halswell Domain

Fylde SME Public running at Thornton Cleveleys from 1pm.

Kings Lynn & District SME, Lynnsport Miniature Railway, 11am-4pm

North Wilts MES public rides, Coate Water Railway, Coate Water Country Park, Swindon, 11am-5pm

Rochdale SME public running, Springfield Park, Bolton Road (A58), Rochdale, pm

Southport MES Public running at Victoria Park 11.30am – 4.30pm

Urmston MES Public running in Abbotsfield Pk 11am – 3.30pm

Vale of Aylesbury MES Public rides, Quainton Rly Centre, from 12 noon.

Wirral MES Public running, Royden Pk, Frankby, 1-3.30pm.

EVERY WEDNESDAY

(Weather permitting)

Bournemouth SME public running, Littledown Pk, BH7 7DX, 11am-3.30pm

Harrow & Wembley SME members meeting, Roxbourne Park, Eastcote, 2.30-10pm

Kings Lynn & District SME, Lynnsport Miniature Railway, 11am-4pm

1 Ickenham SME meeting, 'What we do on Tuesdays' workshop group, Coach & Horses pub, Ickenham, UB10 8LJ, 8pm

1 Portsmouth MES meeting, Members' railway heritage films, Community Room, Tesco, Fratton Way, Portsmouth PO4 8FD, 7.30pm

1 Rochdale SME meeting, members' projects & problems, Castleton Comm Cntr, Rochdale OL11 3AF, 7pm

2 Tiverton MES Running day, Rackenford, contact Chris Catley, 01884 798370

3 Frimley Lodge MR public running, Frimley Lodge Pk, GU16 6HT, 11-4pm

3 Leeds SME Safety Training Day, Eggborough Pwr Stn, DN14 0UZ, 7.30pm

3 York MES members running day, North Lane, Dringhouses YO24 2JE

4 Lancaster & Morecambe ME meet, engineering evening, Cinderbarrow Rly, LA5 9RX, 7.30pm

5 Canterbury SME (NZ) meeting, Halswell Domain, 7.30pm

6 Bradford MES AGM, Saltaire Methodist Church, 7.30pm

6 Bristol SMEE DRO evening, Begbrook Soc Clb, Frenchay Pk Rd, Bristol BS16 1HY, 7.30pm

6 Leeds SME meeting, Jumble Sale, Eggborough Pwr Stn Sports & Leisure complex, DN14 0UZ, 7.30pm

7 South Lakeland MES meet, Pavilion, Lightburn Pk, Ulverston, 7.30pm

7 TIME meeting, Pipers Inn, 70 Bath Road (A39), Ashcott, Somerset TA7 9QL, 7pm

7 Wirral MES meeting, WI Hall, Thornton Hough, 7.45pm.

8 Ickenham SME meeting, Members slides night, behind Coach & Horses pub, Ickenham, UB10 8LJ, 8pm

8 Tiverton MES Bits & Pieces/Bring & Buy, Old Heathcoat comm Ctr, contact Chris Catley, 01884 798370. 7.30pm

10 Leeds SME public running, Eggborough Pwr Stn, DN14 0UZ, from 10am

10 Northampton SME Boiler Testing Day, Delapre Pk, Northampton, NN4 8AJ, 10am-12.30pm

11 Otago MES (NZ) general meeting, 1 John Wilson Drive, St Kilda, Dunedin, 7.30pm

12 Northampton SME meeting, 'Preparing Clan Line for main line' by Richard Gretton, Delapre Pk, Northampton, NN4 8AJ, 7.30pm

13 St Albans ME club auction, Christchurch Ctre, AL3 6DJ, 7.30pm

15 Ickenham SME meeting, Hidden secrets, behind Coach & Horses pub, Ickenham, UB10 8LJ, 8pm

- 15** Rochdale SME general meeting, Castleton Comm Cntr, Rochdale OL11 3AF, 7pm
- 16** Grimsby & Cleethorpes MES boiler test day, Waltham Mill, DN37 0JZ, from 9am
- 16** York MES meet, vacuum braking by R Gibbon/D Ventress, North Lane, Dringhouses YO24 2JE, 7pm
- 16** Midlands Garden Rail Show, Warwickshire Event Centre (The Fosse), 10am-4pm www.largescalemodelrail.co.uk
- 17** Bristol SMEE pre-season briefing, Ashton Court Railway, Bristol, BS8 3PX 7.30pm
- 17** Cardiff MES public running, Heath Park, 1pm-5pm
- 17** Guildford MES Stoke Park Railway open day, Stoke Park, Guildford GU1 1TU, 2-5pm
- 17** Portsmouth MES 'bugs-out' running and adjustments, Bransbury Pk, Portsmouth PO4 9JY, 10am
- 17** Tiverton MES Running day, Rackenford, contact Chris Catley, 01884 798370
- 18** Lancaster & Morecambe ME meet, Threlkeld Quarry and Railway by D Chaplin-Bryce, Cinderbarrow Rly, LA5 9RX, 7.30pm
- 19** Grimsby & Cleethorpes MES meet, Waltham Mill, DN37 0JZ, 7.30pm
- 19** Northampton SME Boiler Testing Day, Delapre Pk, Northampton, NN4 8AJ, 10am-4pm
- 20** Bristol SMEE Spring Auction, Begbrook Soc Clb, Frenchay Pk Rd, Bristol BS16 1HY, 7.30pm
- 20** Leeds SME meeting, 'Restoring a full-size saddle tank' by John Dunn, Eggborough Pwr Stn Sports & Leisure complex, DN14 0UZ, 7.30pm
- 21** Wirral MES meeting, Quiz night, WI Hall, Thornton Hough, 7.45pm
- 22** Ickenham SME meeting, general interest night, behind Coach & Horses pub, Ickenham, UB10 8LJ, 8pm
- 23** Pimlico Light Railway Maintenance Day, Pimlico, Brackley, NN13 5TN
- 23** 9th Model Engineering & Hobbies Exhibition, Michael Herbert Hall, South St, Wilton, near Salisbury, SP2 0JS
- 24** Bristol SMEE Steam-up day, Ashton Court Rly, Bristol, BS8 3PX, 7.30pm
- 24** Grimsby & Cleethorpes MES public rides, Waltham Mill, DN37 0JZ, 12-4pm
- 24** Northampton SME Boiler Testing Day, Delapre Pk, Northampton, NN4 8AJ, 10am-12.30pm
- 24** Portsmouth MES public running, Bransbury Pk, Portsmouth PO4 9JY, 2-5pm
- 24** York MES family running day, North Lane, Dringhouses YO24 2JE
- 25** Canterbury ME AGM, The Barn, Kingston, CT4 6JB
- 25** Harrow & Wembley SME public rides, Roxbourne Park, Eastcote, 2.30-5pm
- 29** Ickenham SME meeting, Indian narrow gauge, behind Coach & Horses pub, Ickenham, UB10 8LJ, 8pm
- 31** Bedford MES public running, Summerfields' Railways, High Rd. Haynes MK45 3BH, 10.30am-3.45pm
- 31** Bristol SMEE public running, Ashton Court Rly, Bristol, BS8 3PX 7.30pm
- 31** Maidstone MES public running, Mote Pk, ME15 7SU, 2.30-5pm
- 31** Otago MES (NZ) running day, 1 John Wilson Drive, St Kilda, Dunedin, 1.30pm
- 31** Portsmouth MES public running, Bransbury Pk, Portsmouth PO4 9JY, 2-5pm

Your club not listed? Send in your details! (see below)

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

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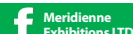
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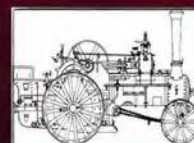
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