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ENGINEERING in Miniature



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in 5-inch Gauge

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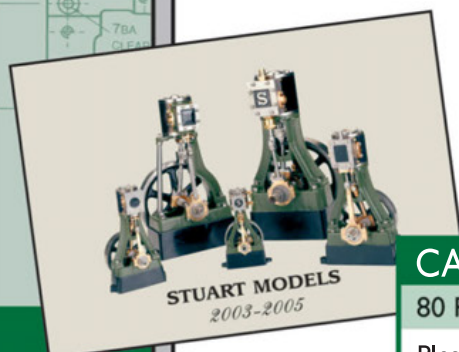


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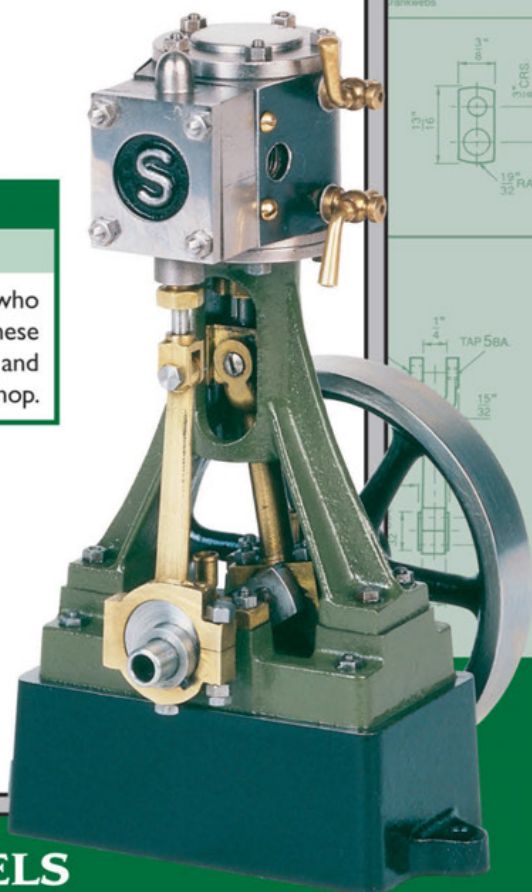
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FRONT COVER

Bruce Boldner has followed up his Midland Spinner with another single-driver, this time of a Great Northern Stirling design. Bruce is seen here at the track with his son.

EDITORIAL

Remembering our founder

Welcome to the July edition of **EIM** and I'm afraid this issue must start on a sad note with the sudden passing of Chris Deith, founder of this magazine and both the Midlands and London Model Engineering Exhibitions – the **EIM** family has lost its patriarch.

As I relate in our tribute to Chris on page 40, I got to know him as an enthusiastic advocate for the model engineering hobby, and a lot more, long before I found myself taking on the editorial hot seat, some time after he sold the title to our present publishers. Mind you having been a reader of **EIM** for very many years I felt I knew him quite well from his editorials, which were never afraid of expressing an opinion while always seeking to advance the hobby.

Model engineering owes Chris a great deal and it is up to us to continue his work by ensuring that the hobby continues to flourish in future.

We have another new loco build project starting in this issue, with Australian correspondent Bruce Boldner following up the superb Midland Spinner that we featured last year with another equally impressive single driver, a Great Northern Stirling. The standard of Bruce's model engineering is very high and it's a pleasure to feature his latest work.

Someone told me very recently that they like **EIM** because they tend to learn something from each issue, and if that's the case then it's good to hear as it suggests we are doing our job properly! Of course it's all due to our skilled correspondents, such as our father-and-son innovators Peter and Matthew Kenington and tech-ed Harry Billmore who keeps coming up with new and inventive ways to solve the various challenges thrown at him in the Fairbourne Railway workshop. While this is miniature engineering on a larger scale, so much of it is very relatable to the smaller gauges, well at least that is what readers keep telling me with Harry's features proving perennially popular!

Talking of Matthew Kenington, our enthusiastic 15-year old has provided us this month with a very good profile of the Hereford SME as part of our recently introduced 'My Club' series. We'd like a few more of these features so if you feel your club deserves some extra publicity, please write in and tell us about it!

Andrew Charman – Editor

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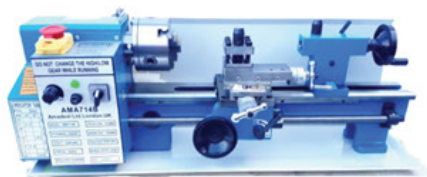
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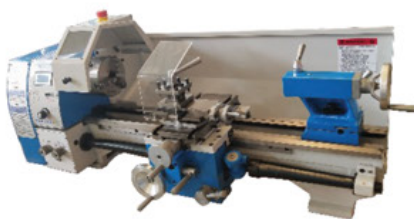


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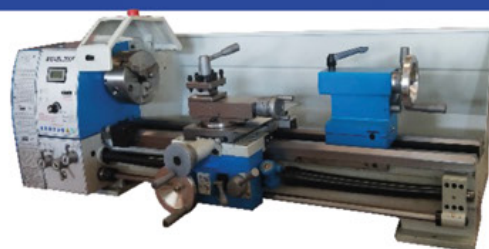
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J. L. North Devon

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A GNR Stirling Single in 5-inch Gauge

Flushed with the success of his first project, the recently serialised Midland Spinner, Australian engineer Bruce begins building another favourite locomotive.

BY **BRUCE BOLDNER** Part One of a short series

In September 2016 I visited England for the first time and enjoyed a day out at the National Railway Museum in York. My daughter accompanied me and I took a photo of her standing in front of one of the huge driving wheels of the Great Northern Stirling Single (Photo 1).

However, my primary interest that day was to find Samuel Johnson's single-driver locomotive of the Midland Railway, as I was constructing a 5-inch gauge model of this locomotive at that time, which was serialised in *EIM* from November 2019 through to March 2020 (Photo 2).

I particularly love the Victorian era of British locomotives, where beauty of form appeared as important as efficiency of function, with beautiful liveries, attention to detail and the pride of their crews that kept them in gleaming condition.

When Reeves announced a discount sale of complete locomotive kits in 2019, I decided to purchase the plans, frames and castings for the 5-inch gauge Stirling Single loco.

Yes, the Stirling was yet another single-driver engine. However it was

"Where the Midland was graceful, the Stirling was grand and a little austere..."



very different from the Midland Spinner. For a start, it had outside cylinders. It also had a different persona for me: where the Midland was graceful, the Stirling was grand and a little austere, especially where the cab was concerned.

The Reeves Stirling model (Designed by David Piddington from drawings by the late J K Scarth – Ed) is based on number 664, the first 8ft single to be fitted with the closed driving wheel splashers and rear dummy sandboxes. The Reeves tender plans I received were for a horseshoe tender, which I later discovered was an Ivatt design – I'll discuss more regarding this later when we get to tender construction.

I have based my model on locomotive number 98, Doncaster Works number 220, which appeared early in 1877. The closing of the open

slotted driving wheel splashers by the fitting of backing plates took place from the end of 1880 onwards.

Dummy rear sandboxes were first fitted from 1881. Earlier members of the class also subsequently received these rear sandboxes.

I have therefore concluded that it is not unreasonable that number 98 would have existed for at least three brief years with open splashers and may well have later received rear sandboxes, this being my preferred visual configuration.

Whereas the Midland Spinner was double framed, the Stirling is single framed and I discovered that the frames on the latter are bent inwards to become progressively narrower in two steps going forward. The first kink inwards occurs just forward of the motion plate, with a further inward bend just forward of the bogie



stretcher – ostensibly to allow more sideways movement of the bogie wheels when negotiating a curve.

However I was to find that during a turn, the rear bogie wheels encounter the frames at the full width section alongside the motion plate, so nothing is achieved with this first kink that I can see. It would surely have been better to reduce the width of the motion plate to allow the frames to be narrower here.

Starting construction

I taped a copy of an overhead view of the frames to a board, then machined some blocks of aluminium to the various frame widths and attached these over the plans at the appropriate points (Photo 3). I then bent the frames until they followed the parameters established by the aluminium blocks, whilst following the frame plan lines between them.

It was important to bend the frames so that they fitted up parallel to the blocks without any pressure and that the lengths between the bends were parallel to each other.

Valances over the bogie wheels further restrict their lateral movement, with these valances bolted to the frames and footplate and the wheels moving within them.

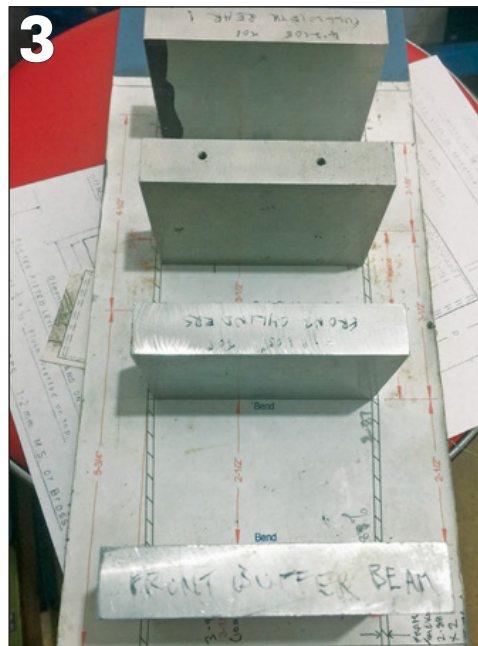
Clearance between the rear section of the bogie valance and the piston slide bars and crossheads is about $\frac{1}{64}$ -inch!

Available sideways bogie movement is increased a little by locating the bogie pivot pin $\frac{3}{16}$ -inch rearward of the stretcher centreline. This reduces the lateral movement of the rear bogie wheels.

After all the holes were drilled in the frames, the horn guides were riveted to them. Then with the frames clamped back to back, the horn guides were machined ready for the axleboxes (Photo 4).

Photo 5 shows the mainframes upside down in the mill vice. You will note the main stretcher immediately behind the driving wheel horn guides. I subsequently decided that the cut-out arch in the stretcher should be uppermost with the frames right side up, to conform with the boiler contour. There was sufficient clearance even with the straight edge under the boiler and I have seen a number of models with the stretcher in this position. However, I decided it was more logical to have the stretcher profile follow the boiler profile and I later reversed this stretcher. I found the plans indeterminate in this regard.

Photo 6 shows the mainframes once again upside down with the bogie frames sitting atop the bogie stretcher. That thin strip of main frame beneath the bogie is somewhat perforated, is it not? The countersunk



HEADING:

Another fine loco from the Bruce Boldner works.

PHOTO 01:

Bruce's daughter provides a demonstration of the size of the Single's wheels.

PHOTO 02:

Bruce with his first loco, the Midland Spinner.

PHOTO 03:

Aluminium blocks provide guide to bend frames to shape.

PHOTO 04:

Machining horn guides ready for the axleboxes.

PHOTO 05:

Frames upside down in the mill vice – note curvature in the centre stretcher.

PHOTO 06:

Bogie frames atop main frames (both upside down). Note thin strip of metal under hole for valve chest

All photos by the author

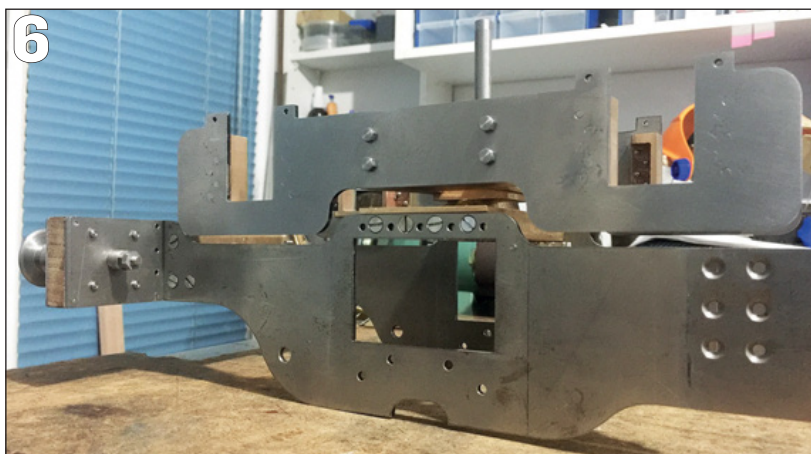


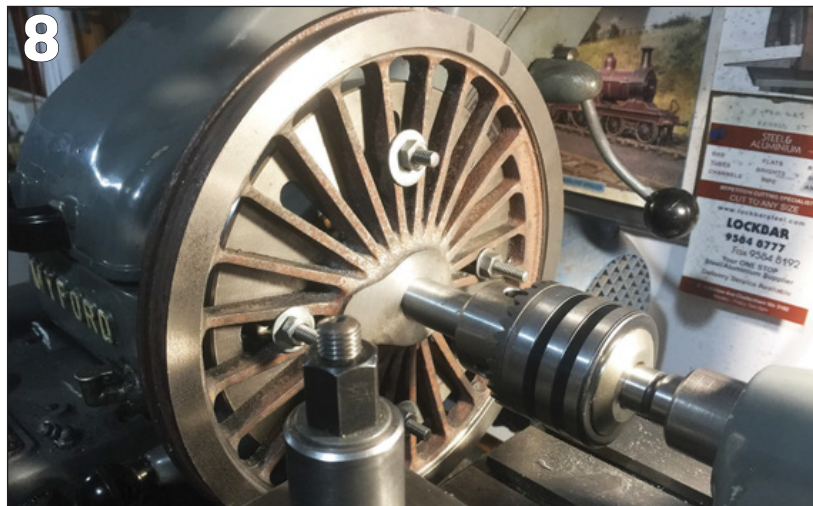
screws secure the frames to the bogie stretcher and the holes each side of these are for the steam chest/cylinder mounting bolts.

I next turned to machining the bogie wheels. I am one of those inferior beings who find it very difficult and time consuming to centre an item in an independent four-jaw chuck. My method is therefore to sand the wheel casting faces reasonably smooth, draw crosshairs

on the wheel boss, then clamp the wheel casting inside-face down onto the milling table. I then drill and ream the axle hole to final size on the mill.

Then I transfer the wheel to the lathe and support the wheel using the same reamer in the tailstock. I advance the reamer-mounted wheel with the tailstock onto the face of the four-jaw chuck and then lightly screw each jaw in until each touches the wheel rim (Photo 7). I then progressively tighten





them, checking that the wheel is not being forced off centre.

When I can slide the reamer in and out of the axle hole using the tailstock, without the reamer catching on the hole, I know the wheel is centred. I then machine a skim off the tread – not to final diameter, but sufficient to create a smooth circumference, concentric and able to be clamped in a three-jaw chuck. I then face off the wheel front and back to final wheel width in the three-jaw.

The wheels are then Loctited to

the axle (with axleboxes trapped between) and the treads and flanges are turned to final diameter between centres in the lathe.

Wheel turning

The Stirling driving wheels are quite large, measuring eight inches and $3\frac{1}{32}$ nds to the flange tips. I therefore used our large club lathe to bore and face off the wheels, but was then able to bring the wheels home and machine the treads and flanges on the Myford, using the same procedure of guiding each wheel into position onto a faceplate using a reamer through the axle hole guided in the tailstock. The cut-out in the Myford bed enabled each wheel to be bolted to the faceplate for machining (Photo 8-9).

I built my Midland Spinner using a Sieg SC4 lathe but I have since purchased a secondhand Myford Super 7 and built the Stirling using the latter. I still maintain that the Sieg is an excellent beginner's machine, because of its variable-speed motor and top-slide digital readout. I also added a digital readout to the lathe bed and even the tailstock.

No belts had to be changed for speed variation as it was all geared. For parting off, a press of a button reversed the spindle direction. As the chuck was bolted on, it could not unscrew.

The Sieg's only weakness was a slightly fragile top slide which was

prone to flex under pressure, occasionally causing the cutting bit to dig into the article being machined.

The Myford is rock solid in this regard and I'm very happy with it. But I didn't wish to wean myself from digital readouts, so have installed one on the Myford lathe bed and another on the top slide. In Photo 10 you will see that I've installed a swarf guard over the readout along the rear edge of the top slide.

After machining and sliding the axleboxes onto the axle, I Loctited both faced-off wheels onto the axle to a back-to-back measurement of 119mm. I then turned the treads and flanges to the final wheel diameter between centres. The width of the top slide with readout scarf guard measures about 117mm – just enough to fit between the wheels!

Photo 11 shows the completed bogie, with coil springs providing the suspension and dummy cast leaf springs doing nothing more than providing an anchor point for the coils. Note that the bogie centre bolster is located $\frac{3}{16}$ -inch rearward of the centre point between the frames, once again to minimise the lateral movement of the rear bogie wheels when in a curve. **EIM**

■ Next month Bruce continues his Stirling Single project, turning to the loco's cylinders and motion.

PHOTO 07:

Using reamer to accurately set driving wheel in four-jaw chuck for machining.

PHOTO 08-09:

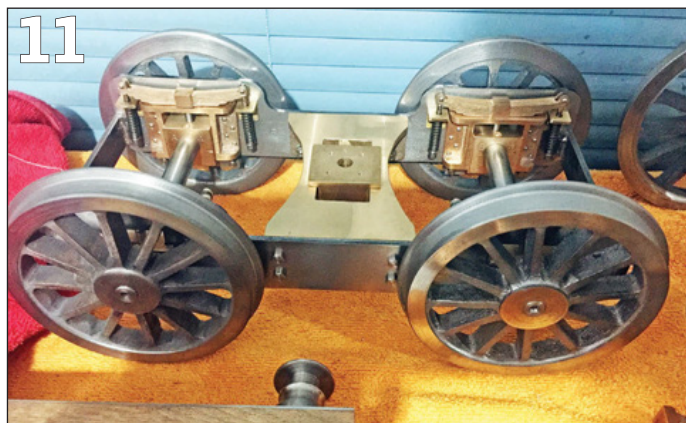
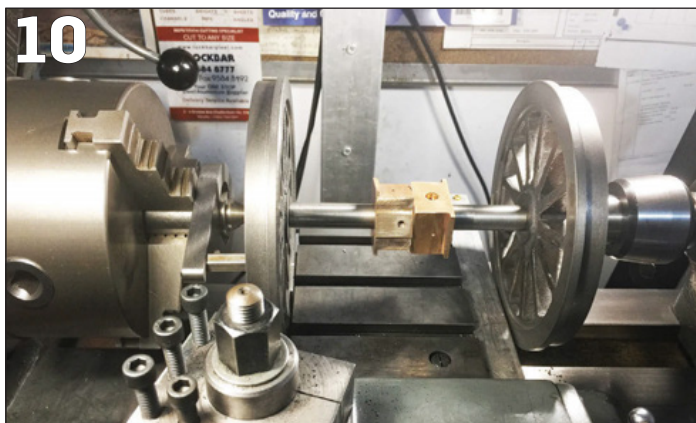
The cut-out in Myford lathe bed allows wheels to be bolted to the faceplate for machining.

PHOTO 10:

Final machining with axleboxes mounted. Digital readout at rear edge of top slide protected by swarf guard.

PHOTO 11:

Completed bogie – the coil springs do all the work while the dummy leaf springs look the part.



An Underwater Railway

In the second of our new series going inside the club scene, young member Matthew takes us on a tour of the highly successful, if weather-challenged, Hereford SME.

BY MATTHEW KENINGTON

A flood-plain may not seem like the most obvious place to put a railway, particularly when it is regularly under a few metres of water – however the Hereford Society of Model Engineers (HSME) has managed to build up a thriving club under just such circumstances. A challenging site requires pragmatic solutions to some of the common requirements of a permanent way – electrical solenoid-operated signals and points are out, for a start. And then there's the giant hogweed...

Still where there are resourceful model engineers, there will a workable track be, and HSME is perhaps one of the strongest demonstrations of this can-do attitude.

A Short History

The Hereford Society of Model Engineers (HSME) was founded in 1962 under the name of 'The Hereford Live Steamers', with six members and only the equivalent of £1.45 in the bank. The initial aim for the club was to become a model engineering society and construct a track. Whilst searching for a suitable piece of land, a new member offered his garden and a 450ft long elevated track for 3½-inch gauge engines was born.

As membership grew, the site became too small to cope, so another member offered his garden, and a 5-inch and 3½-inch ground-level track was built (I hate to think about the musculoskeletal consequences that the regular use of a ground-level 3½-inch gauge railway would bring...). The name was then changed to the The Hereford Society of Model Engineers to reflect the widening interests of the club extending to the

PHOTO 01:

Overhead view of the Hereford track layout (aerial view courtesy of Google Earth, additions by the author)

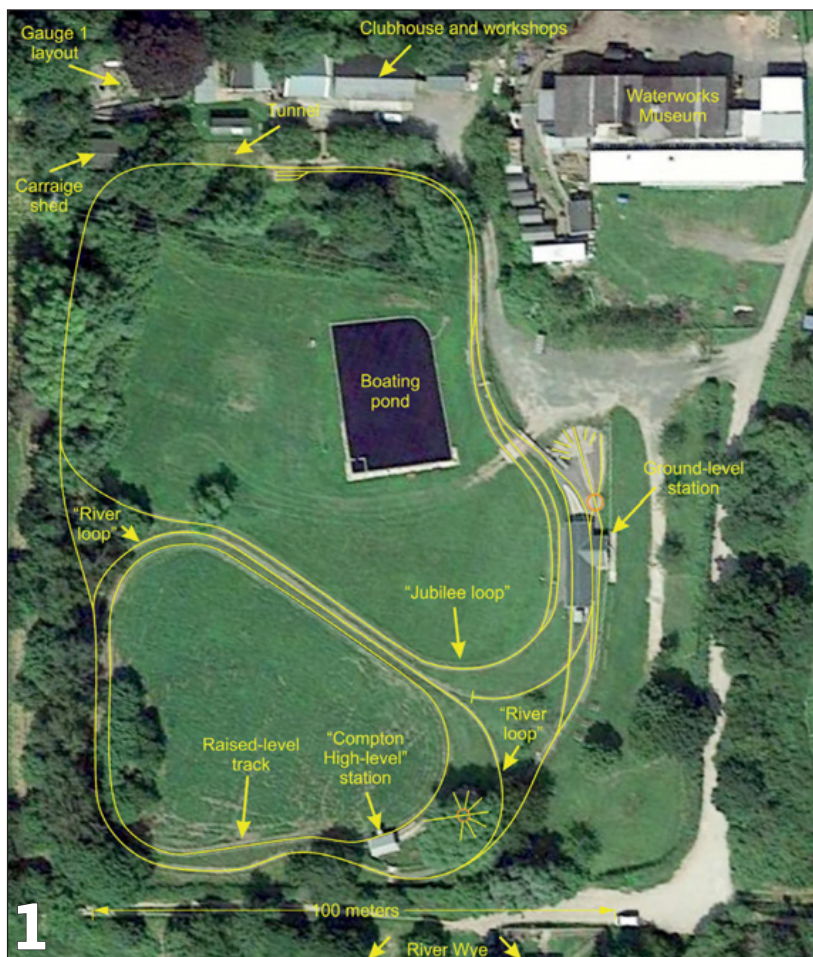
PHOTO 02:

The station on the raised-level track – the author is driving a 5-inch gauge 'Super Simplex' and everyone else is practicing their 'standing around' skills...

PHOTO 03:

Broomy Hill, the main station showing both platforms and the bypass of the 'Jubilee Loop' – young engineer Daniel Bell is driving diesel-outline, battery-electric, club loco 'Yellow Peril'.

Photos by the author unless stated



odd diesel enthusiast. By this point an even larger site was needed, which eventually emerged at our current home of Broomy Hill.

The Site

The Broomy Hill site (Photo 1) is owned by the club. As the title of this article alludes, the site frequently floods and this was one of the reasons

the local council was happy to transfer ownership to the club; there is no way that it can sensibly be developed for housing or any other similar purpose.

The society has adapted to cope with the flooding problem, as will be discussed, and is fortunate in now having a large track and extensive workshop facilities. The various tracks and layouts boast no less than five





PHOTO 04: Steaming bays for the raised-level track – car-park packed on a sunny running day.

PHOTO 05: On public running days, the resident crocodile (or is it an alligator?) emerges from the generously named ‘wildlife pond’ (or ‘ditch’ as the less-generous might term it).

PHOTO 06: Tunnel exit – note the scale on the right-hand wall that allows the depth of flooding within to be judged!

Raised-level track

The raised track is accessed over a level crossing, with a rather novel interlocking gate system for public safety. It is around 800ft long, forming a quasi-triangular shape, with a nice challenging climb back to the station (engendering a satisfyingly crisp ‘chuff’ when driving a steam engine!). It also has full water and coal facilities, and a turntable steaming-bay system (**Photo 4**), with space for seven locomotives.

The club has a fleet of purpose-built passenger carriages for its public running days, and driving trucks, which are fully braked, together with a Class 08 diesel-outline battery-electric locomotive.

Ground-level layout

The raised-level track is housed inside the ‘River-Loop’ of the ground-level track, which departs from Broomy Hill Station. This has space for simultaneous boarding on two trains, with offloading for another two, and a siding for breakdowns (which is, of course, never needed due to the exceptional quality and reliability of the locomotives used at HSME – well, perhaps not more than once or twice per hour anyway).

The station is accessed from the main track or from the steaming bays, which themselves can be accessed from the car park, with ramps for

unloading any size of 5-inch or 7¼-inch gauge loco, including the likes of a Darjeeling or a Thomas II – both have run at HSME in the past.

The steaming bays have full electric blower capabilities, using a car battery charger which feeds terminals mounted below each bay. Both the steaming bays and the station also have their own water supplies – no watering cans here!

The main track from the station leads to the River Loop, which is transitioned once, before the main line (‘outer loop’) is continued, up a fairly steep gradient, to access the ‘Jubilee Loop’. This is also transitioned once, including a trip over a bridge, past the carriage shed (and our cuddly crocodile, **Photo 5**) and on through the tunnel (**Photo 6**), before a further trip through the tunnel and a return to the station.

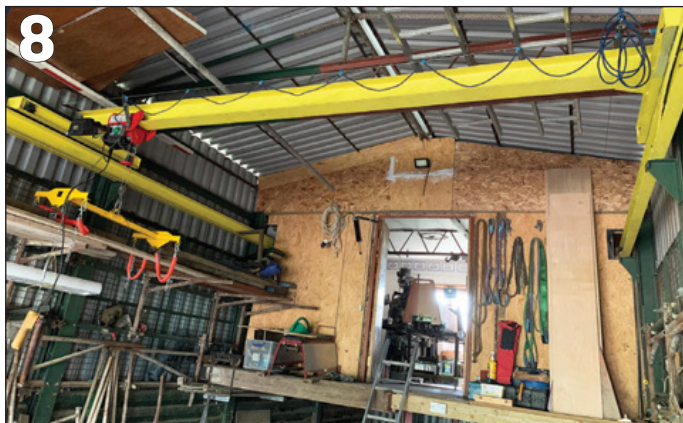
The tunnel, has four tracks, with two being reserved for locomotive and carriage storage. It also has a flood gauge (visible in **Photo 6**), a feature not typically needed at other clubs!

The carriage shed is huge (**Photo 7**), with space for four full-length passenger trains, and a raised-level workshop (mostly, but not entirely, flood-proof) at its rear. The four ground-level tracks are only used for storage in the summer months due to the regular floods when winter comes, so all the carriages and locomotives are lifted by an I-beam crane (**Photo 8**), onto fold-out storage racks, where they will remain out of the water and undamaged. Whilst this system is almost fool-proof, it has been known for the site to flood in July...

Points and signalling

The club’s points and signalling infrastructure needs to avoid the usual electrical solenoid operation used by most similar systems, for obvious reasons. A pneumatic system is employed instead, powered by a large and very noisy compressor which has its own mini-building, at





least in part to reduce the noise!

Whilst this solution is a little slower in operation than would be an electrical equivalent, it works well and response times have been improved by the use of local (to the signal/point) air reservoirs. Most importantly, it is quick to recover from a flood, the air lines simply needing 'blasting out' by compressed air before re-connecting.

During the winter months, the track and full pneumatic signalling system are serviced, with the 5-inch and 7¼-inch dual-gauge points being repaired and oiled, so they can spend another year baffling visitors with their unusual mode of operation (moving frogs are endlessly fascinating – [Photo 9...](#))

The track is also re-ballasted and re-levelled over the winter, although there is no longer any need to replace rotten sleepers, as all are now plastic, with additional metallic 'protection' being provided in the station at the common stopping points for steam locomotives ([Photo 10](#)). Maintenance is carried out by a group of volunteers, who put a large amount of effort into making the ride smooth and enjoyable for both passengers and drivers.

Smaller Gauges

The society has available both OO-gauge ([Photo 11](#)) and Gauge 1 ([Photo 12](#)) layouts, the former being indoor and the latter outdoor. At the



PHOTO 07: The carriage shed regularly floods, despite being located well above the main part of the site.

PHOTO 08: An impressive moving winch system in the carriage shed allows locos and stock to be lifted onto the shelving on the walls or through to the attached workshop

PHOTO 09: Moving-frog points on the ground-level track

PHOTO 10: Aluminium sleepers replace plastic ones as protection against hot ashes inconsiderately dropped by steam locomotives – still, this won't be troubling us for much longer if coal supplies continue their current trend...

PHOTO 11: OO-gauge layout seen through its public-viewing windows.

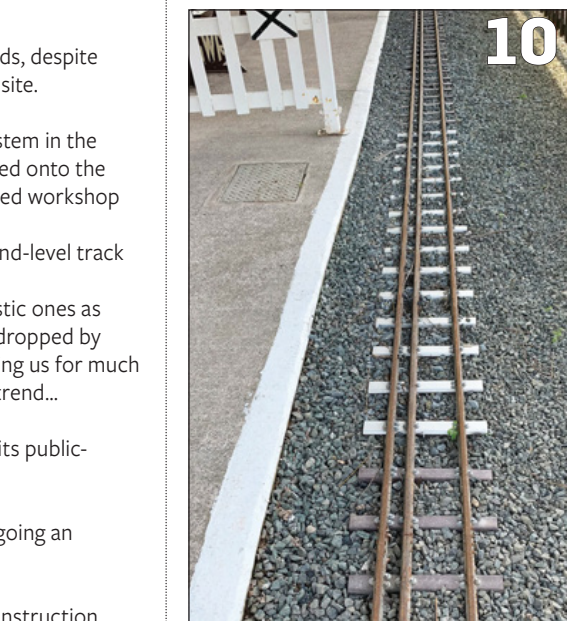
PHOTO 12: Gauge 1 layout, currently undergoing an upgrade, but still functional.

PHOTO 13: The Gauge 1 extension under construction.

time of writing, the Gauge 1 layout is being reconstructed and extended ([Photo 13](#)) and will be an even more impressive facility when complete.

Motive Power

Hereford has a large roster of locomotives, with the three petrol-hydraulics built by club chairman Wally Sykes forming the backbone of the motive power on running days. These are a GWR Autocoach affectionately known as the 'flying banana' ([Photo 14](#)), Santa Fe, an





American goods engine (Photo 15) and Alaskan goods engine 'Alaska' (Photo 16). These each are capable of taking two fully loaded carriages of passengers around the circuit and have been built around 6.5hp electric-start petrol engines.

PHOTO 14: 'Flying Banana' being driven by the author, with fellow young engineer Tom Williams as guard.

PHOTO 15: 'Santa Fe' a petrol-hydraulic with young engineer and regular driver, Daniel Bell.

PHOTO 16: Petrol-hydraulic 'Alaska' having some 'servicing' in the station

Hereford also has a roster of steam locomotives, with an 0-6-0 Romulus called 'Wye', a 1937 Bassett-Lowke 4-4-0 'Sir Walter Raleigh', and a Stafford making up just part of the fleet and now being joined by mine and dad Peter's 0-6-0 Romulus-derivative, 'Idris', on a more regular basis. Finally, there is the club's battery-electric 'Yellow Peril', seen at the head of the train in Photo 3.

The raised track also has a good roster of locomotives including the club's battery-electric Class 08 diesel, an Abbots Model Engineering 'Neptune' (battery-electric), and an LNER B1 which is, of course, steam-powered, together with our Super Simplex 'Roselea'. This ensures that the club never has a lack of motive power, despite the seemingly endless

stream of passengers (we're not complaining, just tired...).

Fighting the floods

As mentioned the unique issue that Hereford has to cope with is flooding of the site (**Photo 17-18**); this happens every winter when the adjacent River Wye bursts its banks. Mud and silt are deposited on the site on a fairly regular basis and flood the boating pond (shown empty in **Photo 19**).

The site will drain when the river level drains (now much more quickly, since the fitting of a new storm drain), but the lower levels still need to be pumped out, a time-consuming job.

Naturally, this poses a challenge for the storage of carriages and locomotives, which have to be lifted onto shelves as described above, and also results in most members taking their locomotives home over winter. Indeed, it has been joked that one of the locomotives, *Aquarius*, would become 'Aquarium' if not moved!

The flooding issue means that the clubhouse (**Photo 20**) and main workshops need to be located up a short hill, which has successfully prevented them from submerging, to date – we keep our fingers crossed. The flooding also makes planting a nightmare – there aren't many flowers that can survive a week underwater!

One thing I've yet to see, however, is an Ark on the boating pond. Given the site's history, it would seem like an apt design to consider...

Workshops

At Hereford there are no fewer than four different workshops, each with its own set of machine tools. The first is just above, and to the rear of, the carriage shed, and features a shaper, Bridgeport milling machine, a Harrison M300 lathe, a horizontal bandsaw and a variety of hand tools.

This is used for large lathe work, milling, and loco testing, due to its proximity to and interconnection with, the carriage shed – it is the workshop I most commonly inhabit.

The next 'Young Engineers Workshop' is housed inside an old

PHOTO 17:

Extent of the issue... River Wye at left, buildings at right form the Waterworks Museum, HSME's clubhouse and workshops beyond. Roof of the main station at near-centre.

PHOTO 18:

Carriage shed on the same day. The yellow RSJ beam at upper-left is the same one in **Photo 8**. Both photos: *Wally Sykes*

PHOTO 19:

The boating pond undergoing refurbishment.

PHOTO 20:

The clubhouse (right/centre) and upper workshop (left).

PHOTO 21:

Young engineers, mentors and parents working on projects – old/broken mobility scooters are excellent donor vehicles for battery-electric projects. The YE workshop is at left and the woodworking workshop at right. *Photo: Wally Sykes*

PHOTO 22:

Young engineer James Knight – a competent signalman on even the busiest running days.



railway goods van, and features a small milling machine, a vertical bandsaw, drill and a grinding machine. Then there is the wood workshop, also in another railway goods van and which features a bandsaw, table saw, belt sanders and numerous other woodworking tools. The final 'main' workshop has both Myford and Warco lathes, and a lovely Forbco drill.

Together, these facilities allow the club to host a thriving Young Engineers (YE) section, as there is plenty of space for us to work in, and the tools to allow us to tackle whatever challenges we want to. There are now more than a dozen young engineers attending our weekly sessions, each progressing their own individual projects with a club mentor and parental supervision.

The YE section (**Photo 21**) is a real credit to Hereford, providing practical workshop training across a range of disciplines. Since joining the club, I have learnt advanced lathe work, milling, plate metalwork, metal bending and forming, brazing, hardening and tempering, toolmaking, MIG, TIG and stick welding, woodworking, locomotive principles and operation, electrics, hydraulics and technical drawing (the old-fashioned way, with drawing-boards and pencils!).

I have obtained both Bronze and Silver 7¼" Gauge Society Awards, plus a couple of FMES/Polly awards. I've designed and built two riding truck/

tenders (in different gauges), an oscillating engine (featured in the pages of *EIM*), a Stuart S50 and a substantial part of a GWR Collett tender – my current project.

The rest of the time I've just wasted (only joking, there is no 'rest of the time'). There is nowhere else, either in my school or anywhere else I know of, where I could have learnt these skills and I'm profoundly grateful to have had the opportunity to do so. I'm now at the stage where I can give a little back, helping some of my fellow YEs with their projects, which is also very rewarding for me.

Hereford's young engineers also assist on running days (**Photo 22**), with setting up, driving, guarding and even signalling (all when of an appropriate age, of course). This means that young engineers and their parents make up a substantial minority of the HSME volunteers on running days; a great asset to the club.

I would like to finish this article by thanking all the volunteers at the Hereford SME, as they make it (in my humble opinion) the best club in the world! Please come and visit us on our annual 'Summer Steam-up' weekend (with an interesting loco!) – these usually take place on the first weekend in July each year and details are provided on the website www.HSME.co.uk – use the 'contact us' section if details are not there. We hope the site will be above water when you visit, but you never know... **EIM**



A North London Tank in 5-inch gauge

Andrew continues his latest project, fulfilling a long-held aim to have a model locomotive with local connections on his roster. This month he works on the boiler.

BY ANDREW BROCK – Part Two of a short series

New Year 2022 and when the weather was warm enough I started bashing copper plates for the boiler of my 5-inch gauge 'North London Tank'. As described in part one of this series, the loosely assembled chassis for the loco had been an 'impulse purchase' from a well-known Internet auction site in a bid to fulfil my desire for a local loco – the one full-size survivor now lives at the Bluebell Railway, not far from my Sussex home.

The backhead plate, front tubeplate, firebox plates and wrapper were cut, formed, filed and ditto several times until roughly the right shape! Some readers will be familiar with this process but for those of you who are not, this is pretty much how it is done. Each plate requires a flange, the outside of which eventually forms the land for the silver-solder bond between the plate and the wrapper, which fits around it.

In order to flange the copper, it must be annealed (softened) and then beaten around a former until it is the required shape. To start with, an approximately sized flat piece of 1/8-inch thick copper is cut and then heated to cherry (bright) red before being quenched in water to cool. This process anneals the copper and makes it easier to form.

Once soft, the copper is then

clamped to its former and the beating begins, using a hide (leather) mallet, so as not to mark the soft copper. Every strike by the mallet 'work hardens' the copper, therefore after so many strikes you have to heat and quench again in order to keep the copper malleable.

For each plate, this process can be repeated multiple times, in between which you may have to saw off some of the excess material before continuing. I enjoy this part of the construction and the key is to keep the copper as soft as possible to obtain the optimum shape.

My flanging formers are 1/2-inch thick mild steel, themselves mostly cut and filed by hand, and with some holes pre-drilled for bushes, tubes and the like. The firebox wrapper, being much longer, is bent around a wooden former, which is actually six pieces of 3/4-inch thick wood glued and bolted together. Once formed, the plates and wrapper were put to one side.

Wrapper from tube

A Christmas present from my parents was a 16-inch length of 4 1/2-inch outside diameter x 10swg (7/8-inch thick) seamless copper tube for the barrel/outer wrapper. To avoid a large lap joint where the barrel meets the outer wrapper above the front of the firebox, I planned to open out just



"I enjoy this part of the construction and the key is to keep the copper as soft as possible to obtain the optimum shape..."

under six inches of the barrel at the rear end to form the sides of the outer wrapper. In doing so, the depth of the firebox is slightly reduced but not by an amount I think will make any significant difference to the locomotive's performance.

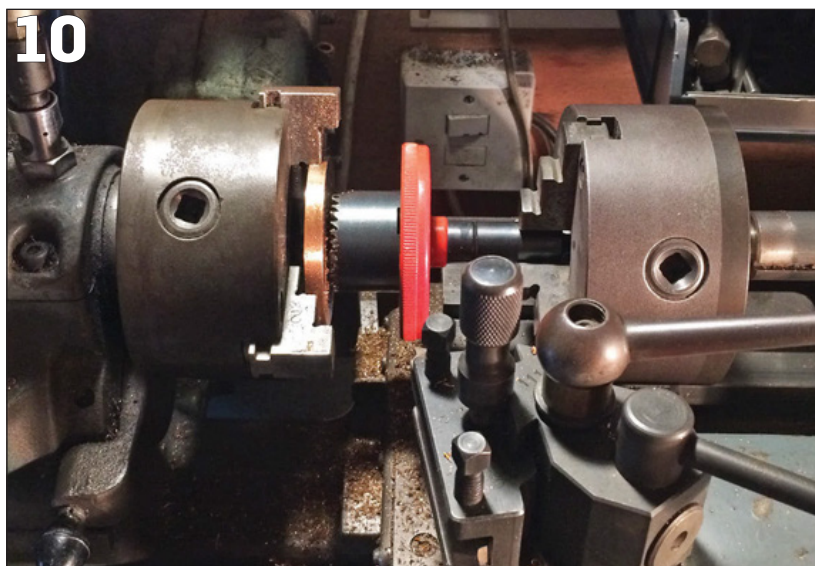
The alternatives would have been a shorter length of seamless tube, with a separate copper sheet wrapper over this to form the section above the firebox, or short extensions to the sides of the wrapper to give an extra depth of firebox.

Working with a tube of this size is not that easy and my first job was to mark the two centre lines along the length of the tube from front to back. The lines were 180 degrees apart and gave me the datum for the top and bottom of the boiler.

Although my 18-inch x 24-inch surface plate lives on top of the work bench, it is rarely used. For the marking on the tube however, it came into its own. The barrel section was placed on the surface plate with four wedges, two underneath each end to keep it still.

Next, and using an engineer's square and dial calipers, I marked the centre at each end of the tube. I then carefully clamped a straight edge along the length of the tube and scribed my centre line along the outside and on the ends. This was repeated for the other side of the tube, making sure the lines were 180 degrees apart!

Once marked, I punched and pilot drilled a 1/4-inch hole for the inner dome. Using half-round and round files, together with a pad saw, I then opened out this pilot hole to a finished



size of 1 $\frac{3}{4}$ -inches, ready to accept the inner dome bush.

The bush itself is a two-piece fabrication, with a $\frac{1}{8}$ -inch thick copper ring for the vertical and a slab of $\frac{1}{4}$ -inch thick PB102 bronze for the top flange. The ring was a simple turning job from an offcut; however the top flange was more complicated. The bronze arrived together with the boiler barrel and was purchased as a (just over) 2 $\frac{1}{4}$ -inch square slab. Because I only required the flange to be $\frac{1}{4}$ -inch wide, and not wanting to waste expensive material, I cored out the centre of the bronze using a 1 $\frac{1}{2}$ -inch hole saw (Photo 10) before holding the bore on the outside jaws of a chuck to turn the outside round.

Now reduced to 2 $\frac{1}{4}$ -inch outside diameter, I carefully held the outside and bored the inside diameter until it was a slide fit over the copper ring. The two pieces were then silver soldered using the higher temperature C4 solder.

Since soldering the dome, I have used the dividing head on the Myford to partially drill and tap the 12 off 6BA holes which will hold the top of the outer dome to the boiler bush. Luckily I suffered no broken drills or taps, which for PB102 was good going. I will fully thread these 6BA holes once the bush is soldered into the boiler.

More recently, I have finished opening out the boiler barrel, test-fitted the firebox plates to their wrapper and flanged/test-fitted the throatplate to the barrel. Holes have been marked and drilled for the fire tubes, the bore for the firehole ring and the fabrication of the firebox crown stay (Photo 11).

As of the last week of April, the boiler was really starting to take shape and the barrel assembly sitting nicely on the chassis (Photo 12) and in the smokebox rear ring (details of this to follow below).

At the buffers

Aside from the boiler, and when it was too cold to work outside, I decided to fabricate the buffer beams/buffers and

“Working with a tube of this size is not that easy...”

PHOTO 10:

Coring out bronze with hole saw to create dome top flange.

PHOTO 11:

Completed flanged plates for firebox and boiler tubeplates, with their formers.

PHOTO 12:

With boiler mounted on the chassis and smokebox rings in place, the project begins to look like a North London tank.

All photos by the author



stocks before continuing work on the final steam inlet/exhaust arrangements to/from the cylinders. The buffer beams are a three-piece sandwich of hardwood between steel.

The $\frac{1}{8}$ -inch thick steel plate, which attaches to the frames, was already in situ when the chassis arrived from Cornwall. I have since added a $\frac{1}{2}$ -inch thick piece of hardwood and then a $\frac{1}{16}$ -inch steel front plate. They are currently held together by means of the buffer stock bolts and additional bolts will be added at the ends of each beam.

The buffers and stocks are all made from bright mild steel and were offcuts from stock. The mounting plate for the buffer stock is 1-inch square with four off 7BA holes at the corners. These were originally 8BA but I found a stock of 7BA studs with plain centres that were exactly the right length to go right through all three sections of buffer beam and the mounting plate, so I used these with one-size smaller nuts. A $\frac{3}{8}$ -inch x

32tpi thread is tapped through the centre of each mounting plate to accept a threaded stub on the end of the stock itself.

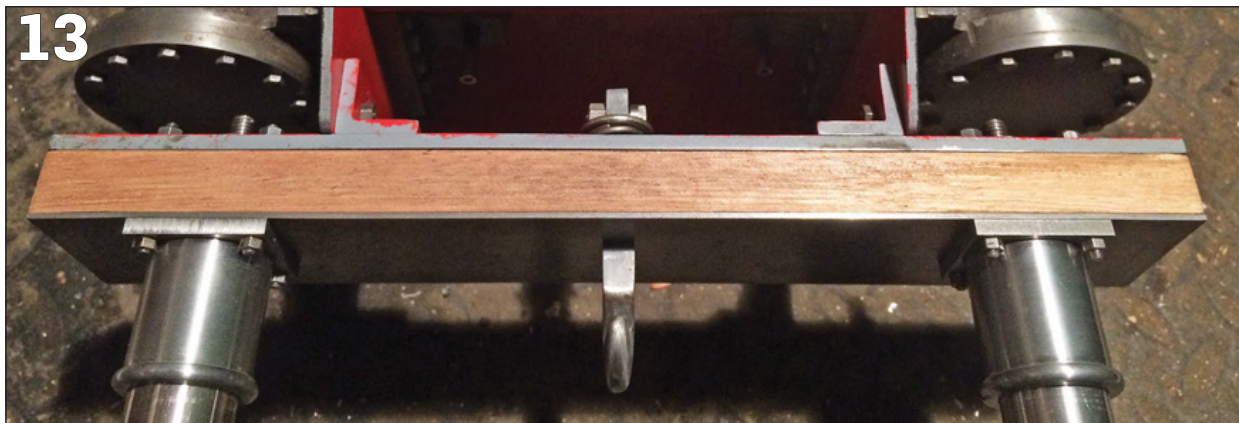
The stocks are $\frac{7}{8}$ -inch diameter, bored out to $\frac{3}{4}$ -inch to accept the shaft which attaches to the buffer head and with the aforementioned $\frac{3}{8}$ -inch x 32tpi x $\frac{1}{8}$ -inch long thread on the end which screws into the mounting plate. A small lip of just over $\frac{7}{8}$ -inch diameter finishes off the front of the stock.

The shaft and buffer head are separate fabrications and are held together by means of a 2BA thread, which is part of a stud that passes through the buffer beam with two locking nuts to keep the spring compressed and stop the buffer head/shaft falling out of the stock! An internal spring of $\frac{3}{16}$ -inch outside diameter by 16swg ($\frac{1}{16}$ -inch) forms the compression.

With the buffer assembly complete, another couple of days were spent fitting these to the buffer beams ▶



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and again I was pleased with the finished products (Photo 13).

Back to the steam pipes and two cross-stretchers were next fabricated from a donated brass slab of $\frac{3}{8}$ -inch thickness. The lower stretcher forms an additional cross-member in the frame, whilst at the same time providing the support for the smokebox floor.

The upper stretcher is the base of the smokebox and will sit on the lower stretcher and form a sandwich, through which the exhaust pipes will pass from the top of the cylinders and into the smokebox. The inlet pipe then passes through the middle of the stretchers and into the inside face of each steam chest. I used a similar arrangement when building my Railmotor (EIM Dec 21-Jan 22) and aside from the added weight, it also means the boiler and smokebox can be lifted off the chassis with just the removal of a few fittings in the smokebox (Photo 14).

Ring cycle

At the same time as fabricating the two cross-stretchers, I decided to fabricate the smokebox front and rear rings. The main reason was to ensure the boiler would sit exactly where I needed it to and if there were snags I wanted to find out now rather than when the boiler is finished.

As it has turned out, the only minor adjustment has been to move the reverser stand out from the frame by $\frac{3}{16}$ -inch and slightly increase the

set in the reach rod. Neither adjustment has seemingly changed the valve gear set up, so good to carry on!

The smokebox rings were cut, filed and machined from two slabs of 5mm thick black steel. A centre point was marked on both plates and from that the outside radius was cut and filed to shape. Careful use of the 6-inch four-jaw independent chuck meant I could now bore both rings by holding on the outside radius and flat base (Photo 15). Taking 5 thou at a time and after several hours turning and plenty of swarf, both rings had their completed bores.

The final job for the time being was to drill six clearance holes for 2BA, three in each ring, so they could be screwed to the top cross-stretcher. A little 'fettling' was required to make the rings slide down between the frames, but with some perseverance and after a trial fit, the front of the locomotive started to look, well more like a locomotive!

With the smokebox setup partially complete, I also decided to finish the odd jobs at the front end of the locomotive before final fitting of the two cross-stretchers into the frames. These jobs included the fabrication of the inlet/outlet pipes, final air testing of the chassis and the production of two tapered wedges, which connect the crosshead to the piston rod.

The latter job was actually done first and was a pig! To internally file a taper through the crosshead and piston rod to match two fabricated

tapered wedges took a great deal of time. Luckily, I had a key file, which looked to be about the right size and was tapered from the front. I worked out the angle of the file and machined two mild-steel wedges in the vertical slide to suit. That was the easy part of the deal.

Next, I filed each crosshead until their wedge knocked through with about $\frac{3}{16}$ -inch protruding top and bottom. This process took several hours and was 95 per cent successful. The wedges knock through and hold well, so fingers crossed they will remain in place! As an extra measure, I also drilled a $\frac{1}{32}$ -inch hole in the centre of the thin end of each wedge and inserted a split pin to ensure they do not try to wriggle free!

With the inlet pipes already in place from earlier in the project, I conducted another air test to check the cylinders themselves. Although 95 per cent sealed, there were numerous minor leaks around gaskets and glands, so I took the decision to remove each cylinder in turn and reseal everything. This ultimately cost me another couple of days but better done now than have too many leaks later on.

Revealing effort

The process was also useful in as much as I learnt a lot more about the construction of the cylinders/valves themselves (Photo 16). The original builder had made some very nice foil gaskets for the chests, but which

"It was all very well thought out and this explained why I had Fairy Liquid bubbles appearing from places I thought impossible when conducting the air test..."

PHOTO 13:

Buffer assembly made up and fitted to beams.

PHOTO 14:

Stretcher 'sandwich' adds weight, provides support for the smokebox and allows easy removal of the cylinders.

PHOTO 15:

Careful boring out of the two smokebox rings, mounting them in the four-jaw chuck in the lathe.

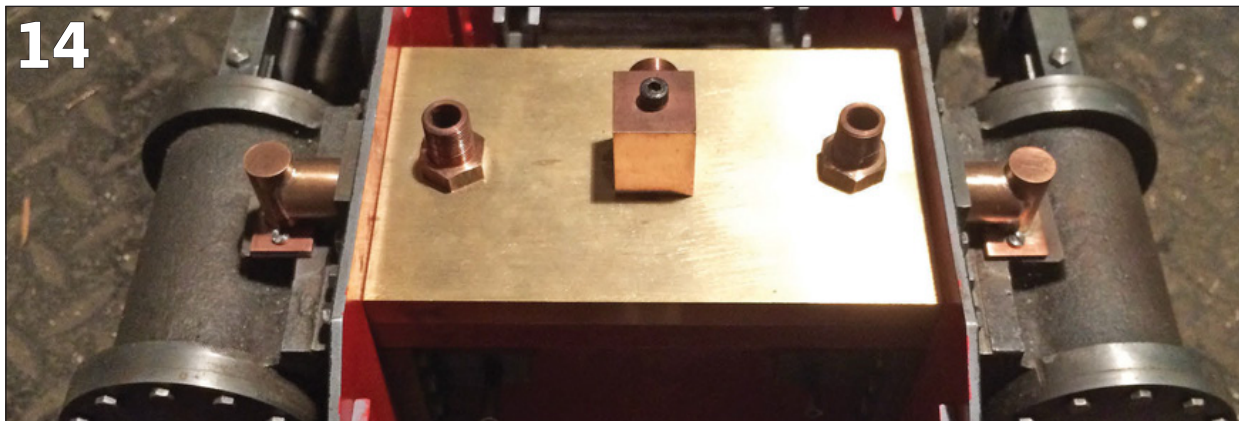
PHOTO 16:

Dismantling and resealing passes revealed much about the cylinder construction.

PHOTO 17:

Steam pipe arrangement again makes for easy removal.

14



unfortunately leaked just too much.

Another oddity was the separate fabrication of the piston rod gland. Normally these are cast into the rear cylinder cover but not in this case. The builder obviously decided to fabricate four largely identical cylinder covers and then bolt the glands to the rear covers. It was all very well thought out and this explained why I had Fairy Liquid bubbles appearing from places I thought impossible when conducting the air test! Needless to say with the application of some Loctite 574 flange sealant, all the faces were now 99 per cent tight. The cylinders were placed back on the locomotive and a final air test proved a success – next stop the exhaust pipes!

With the pressurised side of the locomotive in place, I next moved onto the exhaust pipes. These appear from the top of the steam chests and are outside the frames. From there, they need to turn at a right angle, pass through the frames and into the base of the smokebox, before meeting below the blastpipe.

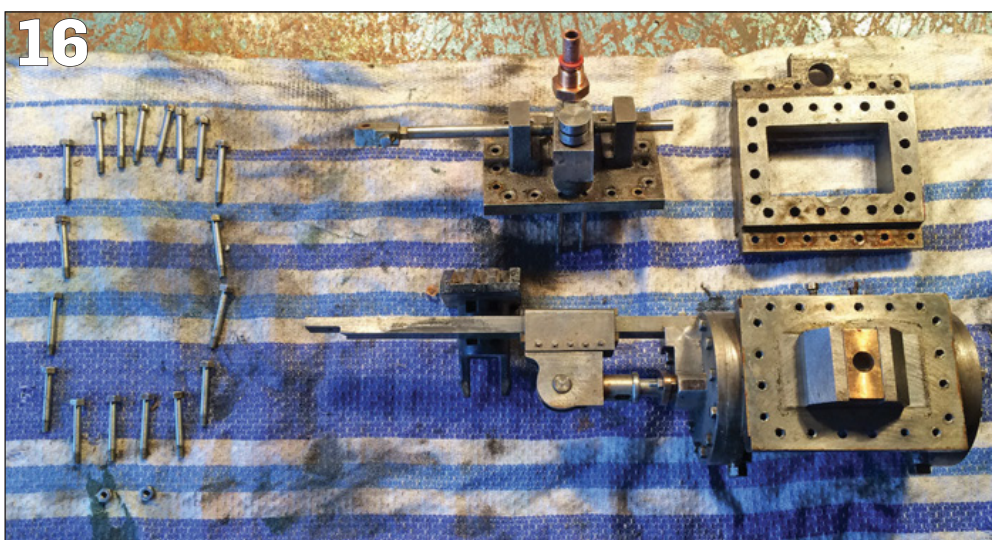
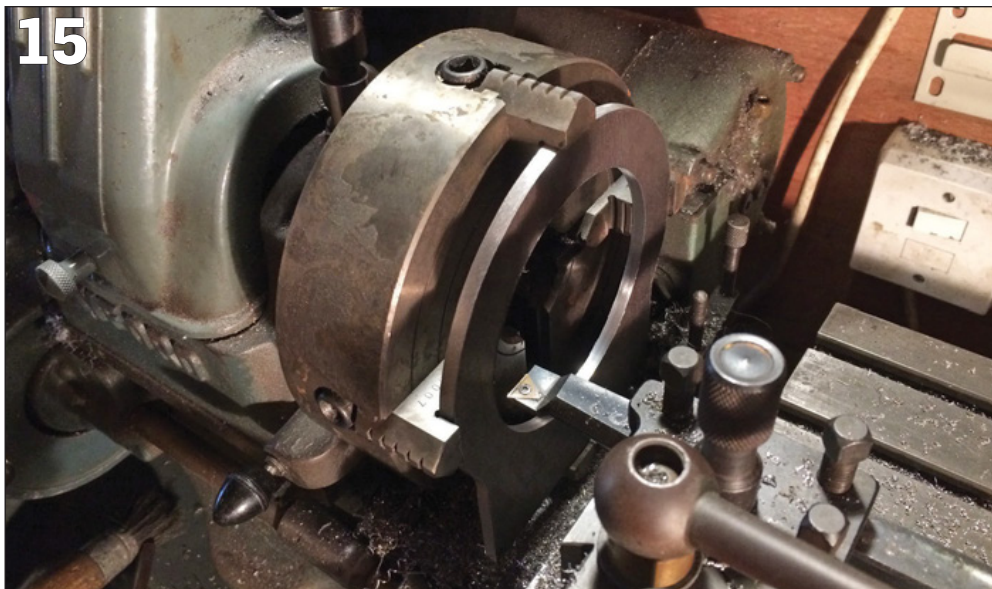
The right angle was facilitated by the fabrication of a silver soldered PB102 bronze elbow. The vertical part was made from $\frac{3}{8}$ -inch outside diameter, drilled $\frac{1}{4}$ -inch and has a $\frac{1}{16}$ -inch copper plate silver soldered to its base to bolt to the top of the steam chest.

The horizontal part was made from $\frac{1}{2}$ -inch and has a $\frac{3}{8}$ -inch hole bored into it to slide over a $\frac{3}{8}$ -inch pipe which takes the exhaust through the frames and the sandwich of cross-stretchers. Another vertical of $\frac{3}{8}$ -inch then comes up through the top stretcher and into the smokebox. This vertical piece is threaded $\frac{3}{8}$ -inch x 32tpi at the top to allow a locking nut to be screwed down on to the smokebox floor and will also accept a pipe fitting, which in turn will lead to the bottom of the blastpipe.

Easy removal

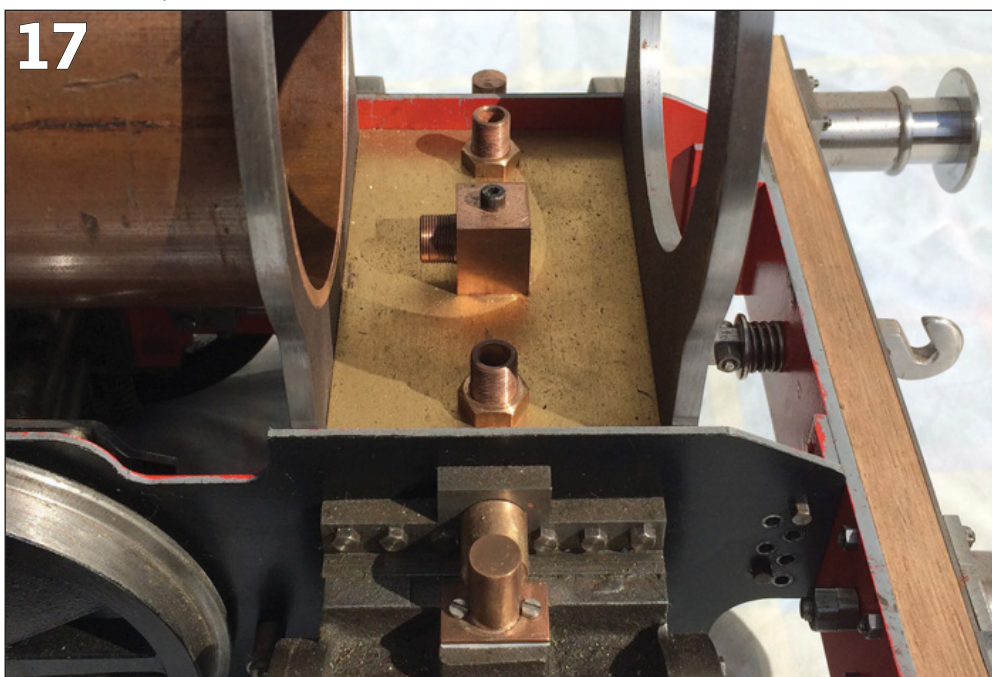
This arrangement means the boiler/smokebox can be lifted away without disturbing the exhaust pipes and in addition, the cylinders could be removed from the frames without having to disturb neither the exhaust pipes nor the boiler/smokebox. Seals are provided by PTFE sheet between the cylinder and copper plate, and an O-ring between the horizontal part of the elbow and the outside of the frames. Fabrication, including the tricky silver soldering and final fitting, took several days but I am very pleased with the result (Photo 17).

As I finalise this article, I am now working fully on the boiler, with the hope of completion within a fortnight or maybe three weeks. A target date of



30th May to display the locomotive at the Bluebell Railway has been set and I would like to have the boiler and smokebox completed in time – watch this space... **EIM**

■ Part one of this feature, describing the work on the chassis, appeared in the March 2022 issue of **EIM**. For details of how to obtain a digital or printed back number see page 30.



Tender Bender

Father-and-son team Peter and Matthew continue their project to build a 'universal' bending tool able to form almost any radius, or virtually none – this month, tube-locating arcs...

BY PETER & MATTHEW KENINGTON Part Two of a short series



Having made the bending rod in last month's initial part of this series, we need to cut the arcs into the ends of the rod. To do this it is important to ensure that the slot is pointing vertically (either upwards or downwards). We opted to point it upwards, as this can easily be achieved using the milling cutter which cut the slot originally, in the same basic setup as was used to make that cut. Placing the cutter squarely into the cut groove and then tightening the vice will adequately ensure that the correct orientation is achieved.

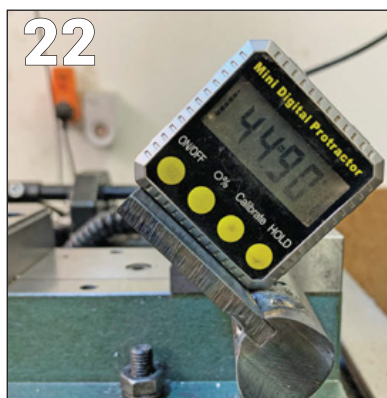
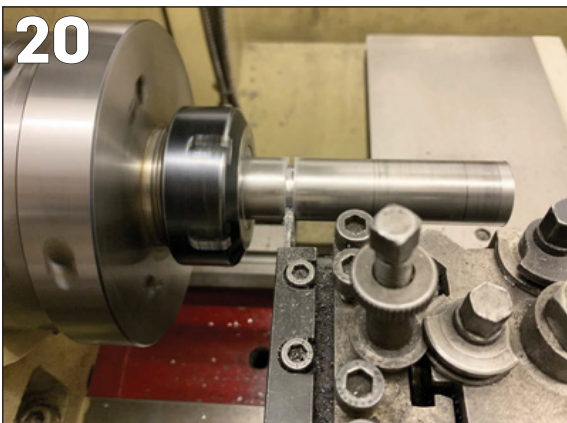
The process of machining the semi-circular arcs in the ends of the rod (Photo 19) was explained in detail in the April 2022 issue of EIM and so will not be covered in depth here. In brief, the process involves calculating the co-ordinate positions to which an end-mill cutter, of a diameter assumed to be smaller than the required arc diameter, needs to be moved to realise an approximation to the required arc. These positions can be calculated by a spreadsheet – the simple process, including the required calculations for inclusion in the spreadsheet, was detailed in the referenced article.

Once the rod and flat plate have been pressed together and a check made to ensure that they are centrally-aligned vertically and horizontally, they may be welded together. A number of short seams should be sufficient – it is not necessary to weld a complete seam along the whole length, although it is a good idea to weld both sides of the joint. A decent weld-penetration is essential however (= lots of amps!).

Alternative Method

If cutting arcs and long slots seems like a daunting prospect, it is possible to omit these operations and replace them with (very) careful setup and welding, modifying the dimensions in Figure 2 (shown last month) accordingly. The flat plate, forming the bulk of the 'blade', can simply be welded directly to the 25mm diameter rod. This option replaces careful milling (of the locating slot) with careful placement and holding of the plate relative to the bar.

To preserve the 'precision' of the tool, the plate needs to be accurately aligned with the rod and accurately centralised on it (and collinear with



"We put this task off for a while, as we thought it would be tricky, but it actually worked out to be surprisingly straightforward..."

PHOTO 19: Cutting arc into end of rod – note that long groove points directly upwards (just visible in photo).

PHOTO 20: Parting-off the guide-tubes.

PHOTO 21: Completed guide tubes.

PHOTO 22: Setting angle for milling V-slot in bending blade – inclinometer read precisely 45 degrees just prior to shutter being pressed...

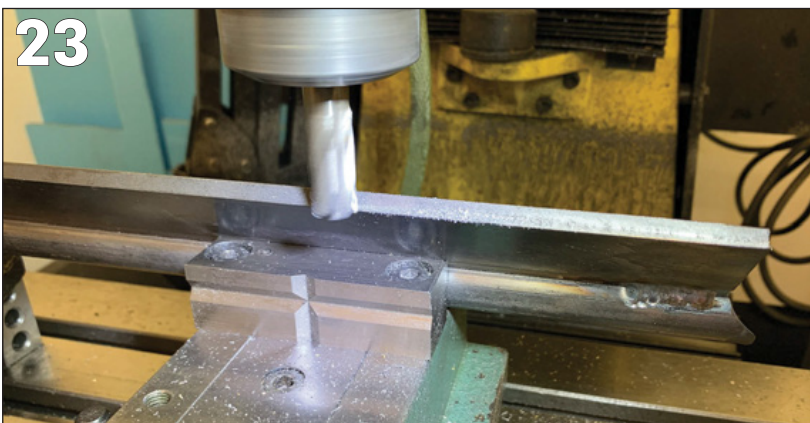
PHOTO 23: Using conventional 12mm end-mill to cut V-shaped slot in bending blade.

FIGURE 3: Dimensions of lower section, largely formed from standard 40 x 20 x 5mm U-section bar.

FIGURE 4: Simple no-weld option for implementing and locating lower V-section former.

FIGURE 5: Alignment indicator profile drawing – extrude this by desired amount (e.g. 20mm) and make 2-off.

FIGURE 6: Bending tool spacer drawing; 2-off needed and can be 3D printed using a filament or resin which is not brittle.



the diameter of the rod). It also needs to be clamped at a number of points along its length, otherwise there is the danger of the plate warping due to the extreme heat of the welding process – we are dealing with pretty thick pieces of metal here! Finally, the guide-tubes (discussed below) need to be both parallel to, and centrally-located on, the ends of the plate. They also need a good fill of weld, as much of the bending force from the tool will impinge upon these welds.

We weren't confident that we could do a good job of all of these things simultaneously and so elected to mill a slot and arcs instead.

Pipe Dreams

The guide-tubes were made from sections of stainless-steel pipe with an outside diameter of 25mm and a wall thickness of 4mm (leaving 17mm internally to accommodate the 16mm diameter threaded rod). These were simply parted-off from a single (longer) length of tube (Photo 20), with two identical examples being required (Photo 21). Using stainless steel saves having to worry about rusting of the internal bore of the tubes – these are relatively difficult to paint and any that is applied is likely to be scratched-off, in use, by the abrasive action of the threaded rod.

V for Victory

The final operation on the blade is perhaps the most tricky: cutting a V-groove in the long length of the blade-plate. The precise form of this slot is shown on the right-hand side of Figure 2 and in the detail view 'A' on that drawing. We put this task off for a while, as we thought it would be tricky, but it actually worked out to be surprisingly straightforward. Again, it required the workpiece to be repositioned a few times, for the same reasons as discussed previously in relation to the long 6mm slot cut into the 25mm rod, but otherwise, the process was remarkably simple (and much quicker than cutting the slot).

The basic setup is shown in Photo 22. The (now welded) rod-and-plate structure is held in the machine vice relatively close to the end of the structure (to prevent undue vibration when cutting). The rod is gripped in the vice jaws, with the attached plate resting on an upper corner of one jaw. An inclinometer is used to then set the angle of cut, with any deviations from horizontal of the mill bed or vice being taken into account in the reading sought on the meter. The required angle is, of course, 45 degrees to the surface of the plate.

Note that depending upon the dimensions of your vice jaws, you may need to include a parallel (for

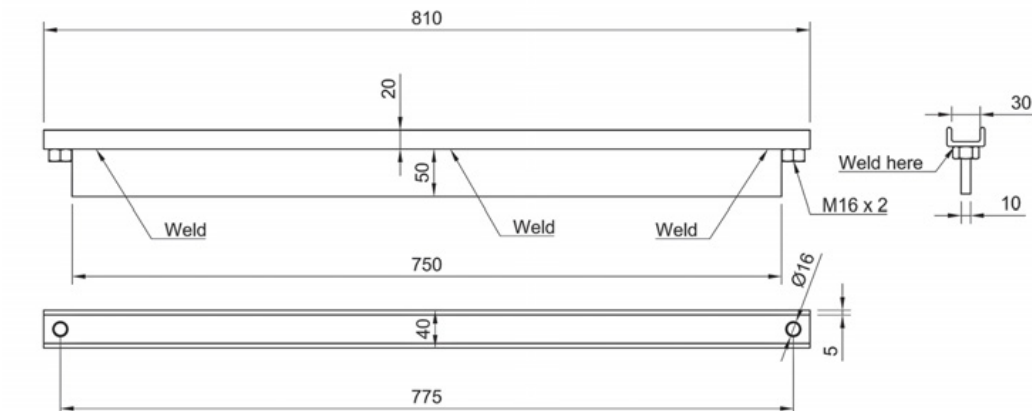


FIGURE 3

Approx one-eighth full size

example), lying flat between the jaws, in order to provide a horizontal reference for the rod to be pressed against whilst tightening the jaws. An assistant, if available, can be handy for this part, although it is possible to do it alone (my young assistant was busily fitting some draincocks to a loco at this point, unfortunately).

The secret to a fast cutting time is to use a (relatively) large cutter. Since only the 'corner' of the cutter is used, the size of cutter is unimportant (above an obvious minimum). We used a 12mm end mill and this worked well. The cutter needs to be positioned an equal amount across and down from the corners of the blade. Since the blade is 6mm in thickness, a little basic trigonometry shows that the horizontal and vertical displacements required are (both) equal to $\sqrt{18}$, which is approximately 4.24mm. With these values, the milling process should look like that shown in Photo 23, with the final setup (with the machining nearing completion) shown in Photo 24.

With the V-slot milled, the final task is to add the guide tubes, however this is most easily done at the end, since the handles and threaded rod can be used to 'clamp' the whole system in place (vertically, at least) and this makes achieving an accurate setup easier. We will therefore return to this aspect a little later on.

Lower Section

The lower section of the bending tool is pretty straightforward. The main dimensions of the part are shown in Figure 3, with the key component being formed from a length of standard U-channel 40mm wide by 20mm high, using 5mm thick mild steel. The two 16mm end-holes are drilled in this (Photo 25), with the remaining components, the bracing plate and the two M16 nuts, being welded to this U-channel. Again, as with the guide tubes, it is best to weld the nuts in place once the whole tool is test-assembled, in order to ensure that they are located in exactly the correct place relative to the 16mm holes in the U-channel.

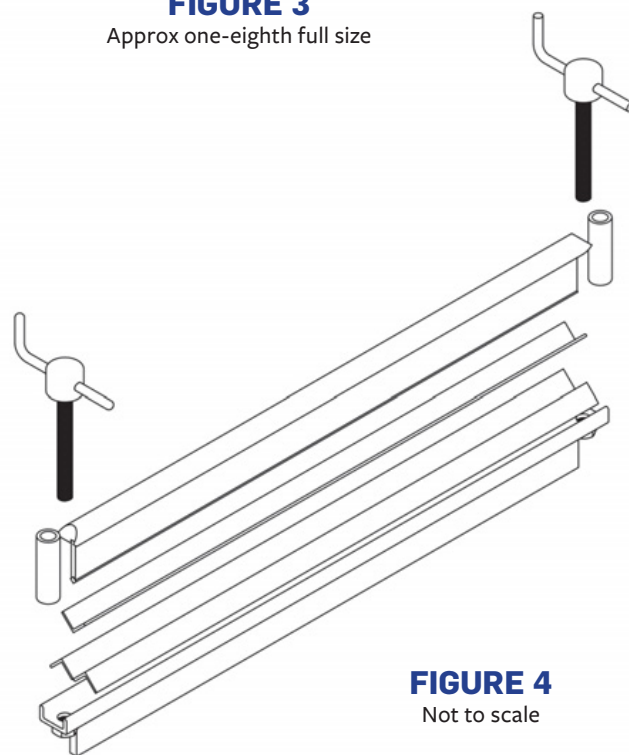


FIGURE 4

Not to scale

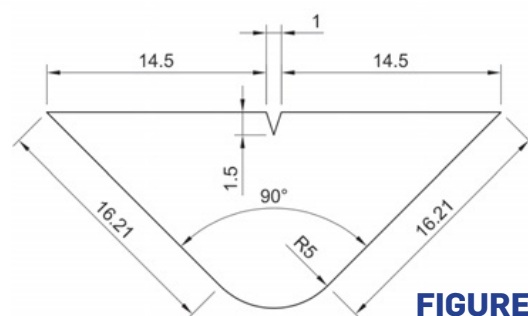


FIGURE 5

Approx twice full-size
2 off required

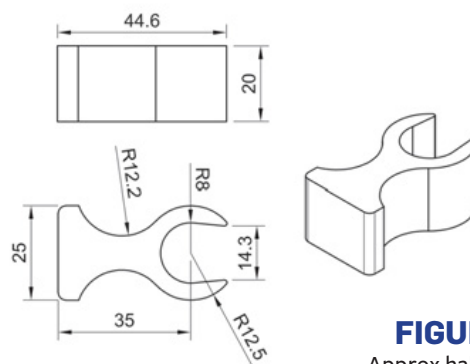


FIGURE 6

Approx half full-size
2 off required

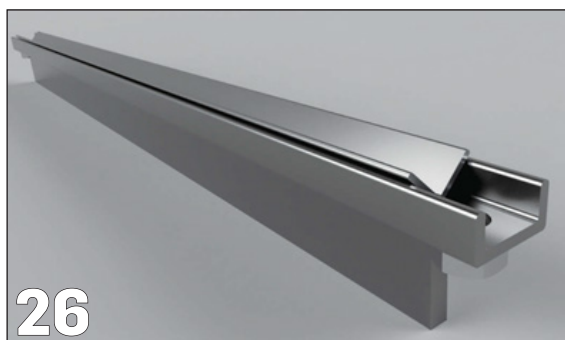


PHOTO 24: Very long piece needed to be re-set in vice three times during cutting process.

PHOTO 25: Drilling 16mm hole in end of U-channel support piece, ready for threaded handle component and nut.

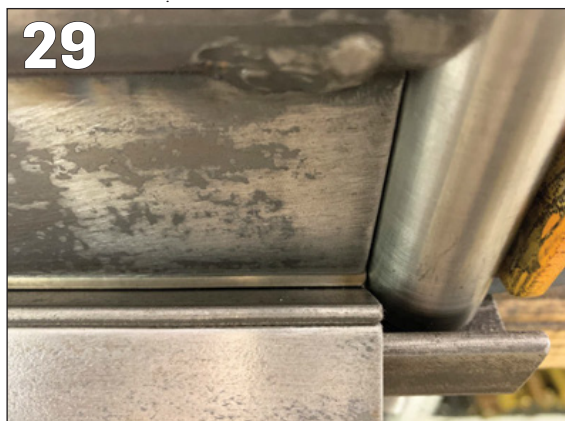
PHOTO 26: Alternative (captive) method of configuring base-section. Now single piece of angle can be welded into place along its length.

Additional Parts

The eagle-eyed among you will have spotted a discrepancy between Photo 2 and Figure 3; the former contains a length of angle supported by the U-section piece in the lower part of the tool. The reason that this has not yet been discussed is that there are options which can now be outlined.

One is simply to include a 750mm length of 25mm x 25mm x 3mm (or 5mm) angle, as shown in Photo 2 and, in more detail, in **Photo 26**, and to weld this to the U-section piece. This is a perfectly acceptable solution, although it does take away a little future flexibility and so we didn't go down this route. Note that these welds don't need to be especially good or extensive, since the basic strength of the lower section comes from the 10mm plate used to grip the tool in a vice (and, to a rather lesser extent, the U-section).

Another option is to machine and add some triangular cross-section spacers between the angle and the



U-section, to ensure that the length of angle remains centred and doesn't 'pivot' on its outer corner (or bottom corner, as oriented in the tool).

The final option (which we chose) is to add two further lengths of angle, as shown in **Figure 4** and **Photo 27**. This is very quick and simple, since the added lengths of angle don't need to be welded in place (although they could, if desired, be tack-welded together) – they 'self-centre' in the U-section bar and hold the main piece of angle quite securely.

This setup is easily disassembled, allowing an alternative part to be inserted into the U-section, if needed. We have some ideas about a shorter, raised, piece for this part, to allow a corner to be formed perpendicular to the flares on an already-flared component (for example the rear corners on our tender tank side panels). We will work out the details of this option nearer the time, but wanted to retain the flexibility to include such a solution within the envelope of the tool.

Note that the piece of angle into which the sheet material will be bent, when the tool is in use, needs to be smooth on the inside of the angle. Any blobs, blemishes and such (and, indeed, any grit) will be pressed into the metal, or may scratch it (depending upon the bending operation being performed and where exactly the offending material sits on the face of the angle). Judicious use of emery cloth and a little elbow-grease should be all that is required.

Final Assembly

The last step is to assemble the whole tool and complete the final welds. An exploded view of the assembly arrangement is provided in **Figure 4**. This clamps together solidly using the handles and their attached screw-threads and the guide-tubes can be held in place using a sash-clamp, as shown in **Photo 28**, ready for welding.



PHOTO 27:

Close-up of bender base end section, showing use of two additional pieces of steel 'angle-iron' to centre the piece used to form the bend. 6mm square cross-section rod (shown in Photo 44) included to show fit of this part when in use.



PHOTO 28:

Using sash-clamp to hold guide-cylinders in place for TIG welding.

PHOTO 29:

Close-up of area to be welded – nice tight fit due to use of arc-cutting technique described in EIM, April 2022.

PHOTO 30:

Guide-cylinder TIG welded to end of bending blade.

PHOTO 31:

With blade in place, showing need for gap between bottom of guide-tube and bottom of U-channel base.

PHOTO 32:

Finally, turn it all over and tack-weld nuts to base-channel.

PHOTO 33:

3D-printed alignment guides.

PHOTO 34:

3D-printed spacers made from an 'ABS-like' SLA printer resin.

PHOTO 35:

Diagram showing location of spacer when in use.

All photos and diagrams by the authors

All being well, you should end up with a fit which looks like Photo 29 and results in a welded part looking like Photo 30 (but your welds will be better, of course...).

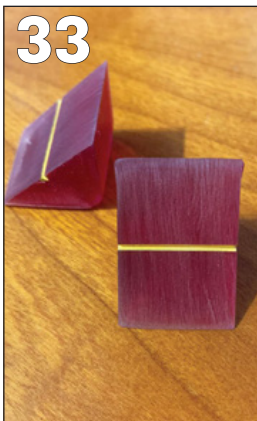
The guide tubes should be tack welded with the sash-clamp in place and then seam-welded once the clamp has been removed. Note that these welds need to be good, as the full force of the bending process is taken by them – no pressure then...

Note also that there should be a gap between the bottom of each guide-tube and the bottom of the U-section bar when the tool is fully clamped down, as shown in Photo 31, (with no work-piece material being bent) – if you follow the drawings accurately, then this will be the case.

With everything clamped tightly in place, using the tool as if it were fully-bending a sheet of metal, but without any material present, the tool can be inverted and the M16 nuts welded in place (Photo 32). A couple of decent tack-welds should be sufficient, as there will not be a huge rotational force on these parts.

Alignment Guides

Alignment guides can be added, to enable accurate alignment of a bend on the tool. These are especially useful for the flaring application of the bender, as it is otherwise difficult to accurately align the large-diameter bending rod to a line on the



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workpiece. The guides are inserts which sit in the angle-iron channel during setup of the bend and their profile is shown in Figure 5. The mid-bend line on the workpiece can be aligned with the narrow centre-lines on the guides and the workpiece then held in place, for example using neodymium magnets, as will be discussed. The alignment guides are then removed, prior to commencing the bending operation (they would otherwise be crushed!).

The guides may be made from any suitable material: plastic, metal, even wood – we 3D printed ours using an SLA (Stereolithography) 3D printer and an 'ABS-like' resin. The final items, after painting the centre-line, are shown in Photo 33 and an example of their use will be discussed later in the series.

Spacers

Another handy accessory, which can also be 3D printed, is a set of spacers for use when setting up a bend. These hold the bending blade above the anvil or angle-iron pieces whilst a piece of sheet metal is inserted into the bender (and lined up using the guides described above). This allows both hands to remain free to undertake alignment duties without needing one of them (or an assistant) to hold up the blade whilst this is done.

Our initial experimental bends made use of the 'assistant' option,



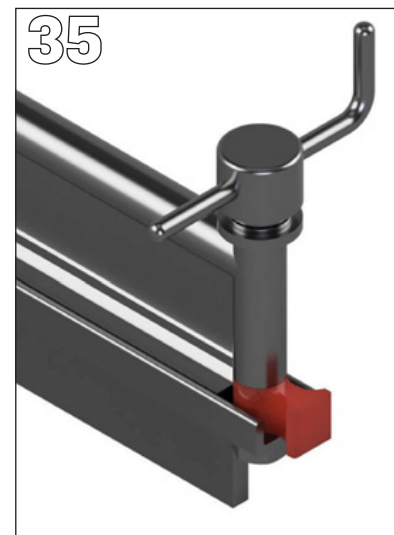
since there were two of us, but even this was less-than-ideal as we kept getting in each-other's way! These experiments quickly led us to realise that a better option was needed and the concept of these spacers was born.

The basic design is shown in Figure 6, although obviously a wide range of variants could successfully achieve the same ends. The versions we made are shown in Photo 34. The idea is that the spacers clip around the exposed screw-thread, at each end of the bender, in the same way a pipe-clip attaches to a piece of domestic copper pipe (Photo 35). In this way, they support each end of the blade during setup and can then be removed immediately before bending begins.

Alternatively, a standard 15mm pipe-clip may be able to be pressed into service with some slight modifications to the inside diameter. More than one may be required at each end, depending upon the thickness of the pipe-clip design in question. EIM

■ The Keningtons continue the build next month by adding an accessory to enable the creation of sharp bends in metal.

Part one of this series was published in last month's issue of EIM – to obtain either a printed or digital copy of the edition, see page 30.



Heavy Goods in Steam

Rodger describes the short – lasting only around 40 years – but important role played in the UK transport industry by the steam lorry.

BY RODGER P BRADLEY

Towards the end of 2021, one of the most highly publicised transport problems was a shortage of HGV drivers in the UK, and in the middle of a pandemic. The country's dependence on the road haulage industry was never more widely discussed.

Land transport of goods – be it livestock, perishable foods and commodities for domestic and commercial use, or as part of a production process – has always included an element that needed haulage on the roads. Yes, the railways provided a key role in bulk haulage in the second half of the 20th and into the present century, but for both short, intermediate and long-distance goods transport, road haulage has become the mainstay.

Whenever we use roads for our own personal transport, we will inevitably either follow, or see large numbers of HGVs carrying all manner of goods, in containers, on pallets, or tanks of oils, powders and everything in between. The prime mover in every case will be a diesel engine, allied to sophisticated transmission systems, with controls and braking using hydraulic and air-operated components, along with computer monitoring and control systems.

The same was true of the first heavy goods vehicles powered by steam engines. These also often included trailers attached to the rear of the main vehicle, much like the 'semi-articulated' lorries of today. Although the earliest vehicles were often described as 'steam vans' or 'steam waggons'.

Artic ancestors

The names of Leyland Motors, Thornycroft and Foden were synonymous with lorries and road freight haulage in Britain and elsewhere, and more than 100 years ago these names were becoming famous for their steam-powered juggernauts. Well perhaps juggernaut is too exaggerated a description for while they were certainly heavy and cumbersome machines, they were the forerunner of today's articulated lorries that ply our motorways.

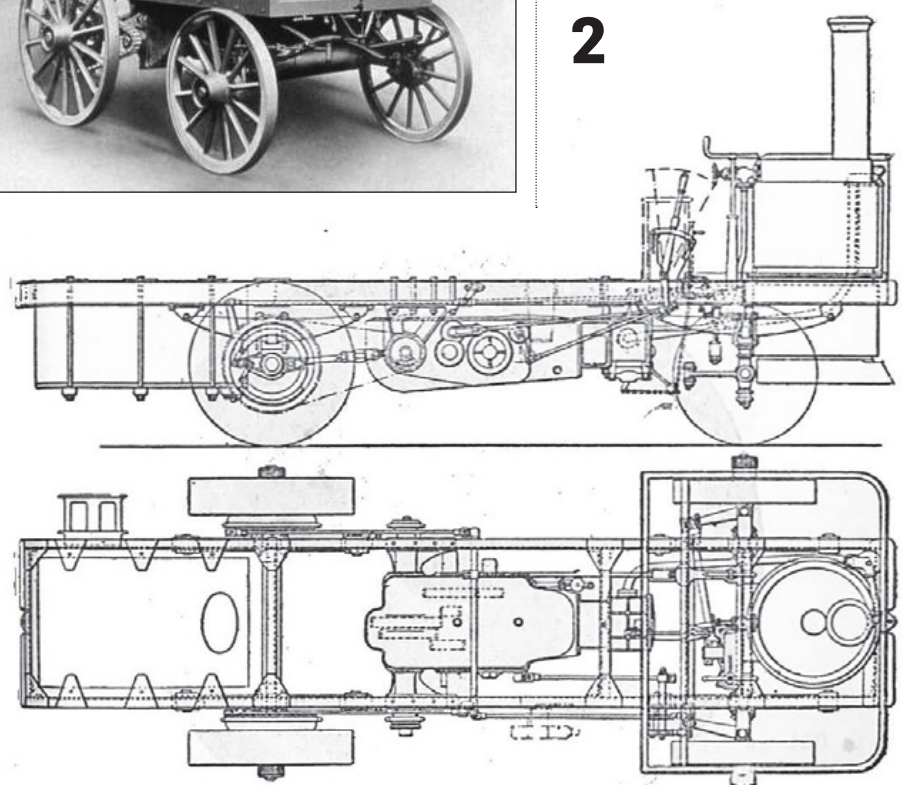
Interestingly, the earliest steam road wagon builders at the end of the 19th century were to be found, like their railway predecessors, in the



ABOVE: These Sentinel products, at a rally in Shrewsbury where they were built, represented the zenith of steam wagon design. Photo: Andrew Charman



PHOTO 01: The pioneering 1.5-ton van from Lancashire Steam Motor Co., with its undertype engine. The spoked, wooden cart wheels perhaps belied its agricultural heritage.



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LATEST TYPE OF THORNYCROFT STEAM WAGON.

PHOTO 02:

The general arrangement view of the classic Leyland steam undertype wagon, dating from 1911.

PHOTO 03:

Thornycroft was a major force in the early days – here an 1899 ‘steam wagon’ hauls a trailer.

PHOTO 04:

Vertical multi-tube boiler used on vehicles of the Lancashire Steam Wagon Co. Diagram taken from the Army Service Corps Training (Mechanical) Manual, 1911.

PHOTO 05:

Leyland product operated by the Belfast & County Down Railway. Still very little crew protection, but dramatic changes to the style of wheels.

Uncredited images via Wikipedia Commons

north of England, although a couple appeared in East Anglia, and one at least south of the Thames.

The north was, however, most popular undoubtedly because of the concentration of heavy industries and large-scale manufacturing in these areas. Amongst the most prominent

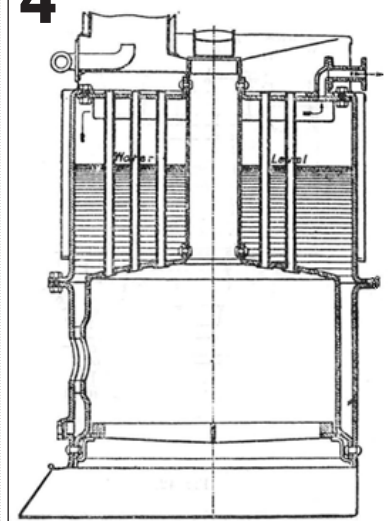
heavy goods builders of their time were the companies listed below, with the Lancashire Steam Motor Co. Ltd. being perhaps the first truly successful entrant into the field in 1896.

The first product was the ‘One Ton Steam Van’, which demonstrated the success of a steam-powered, self-propelled road vehicle, with a vertical fire-tube boiler supplying steam to the cylinder carried beneath the floor of the van. The following year, a second design, a 4-ton van was built, but this time fired by oil and sporting a large condenser on the roof of the cab.

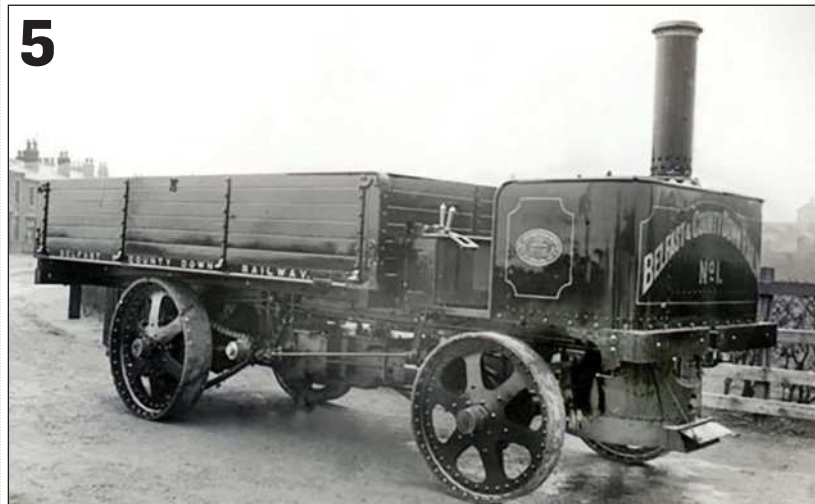
This was the same year that the ‘Locomotives on Highways Act 1896’ came into force, which changed the restrictions on road-going steam locomotives and removed the need for a crew of three – including the man with the red flag walking ahead of the steam tractor/locomotive.

The Act introduced speed limits based around the weight of the vehicle, which sadly meant that the second Lancashire steam van – the 4-ton design – failed to meet the new

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regulations. It was hastily re-engineered as a result in time for the Liverpool Self-Propelled Traffic Association Trials in 1898.

Wagons on trial

Another important influence on the various designs of steam road wagons at this time were the trials held under the auspices of the Royal Agricultural Society and the Self-Propelled Traffic Association, with events held at Crewe and Birmingham in 1897 and 1898. The trials demonstrated in particular the worth of what would become the Leyland design, although of course there was some fairly stiff competition. The success of this company naturally sent the other builders back to the drawing board to make improvements.

The Liverpool Self-Propelled Traffic Association Trials in 1898, '99 and 1901, had the intended purpose of finding an improved form of transport from the port of Liverpool to the industrial towns, and with a booming cotton industry this mattered. For the 1901 trials, the classification introduced four categories – published in *The Engineer* for May 31st 1901 they were:

Class A: Load, 1½ tons; maximum tare, 2 tons; minimum level platform area, 45 square feet; minimum width of driving tires (*sic*), 3in.; speed, eight miles per hour.

Class B: Load, 5 tons; maximum tare, 3 tons; minimum level platform area, 75 square feet; minimum width of driving tires, 5in.; speed, 5 miles per hour.

Class C: Minimum load, 5 tons; no tare limit; minimum level platform area, 95 square feet; minimum width of driving tires, 6in.; speed, 5 miles per hour.

Class D: Minimum load, 4 tons; no tare limit; level platform area not specified; minimum width of driving tires, 4in.; speed, five miles per hour.

In the 1898 trials no fewer than 10 vehicles were entered – their builders listed below:

- 1) LIFU (Liquid Fuel Engineering Co. Ltd), London
- 2-4) The Steam Carriage and Wagon Co., (Thornycroft), Chiswick
- 5) The Lancashire Steam Motor Co. ('Leyland')
- 6) The LR Syndicate Ltd (Serpellet System), London
- 7-8) T. Coulthard & Co., Preston
- 9-10) Robert Cooke Sayer, Bristol

Only four of these entrants actually made it – the LIFU No.1, Thornycroft's No. 3 (an articulated 5-ton wagon) and No.4, a 3-ton steam wagon, and the Leyland 4-ton steam lorry, no. 5. After a series of trials and tests for efficiency, performance and manoeuvrability, the Leyland was

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awarded first place, and £100 (equivalent to around £9,000 today – Ed), with the LIFU second, winning £75, whilst the Thornycroft came in third and picked up £50.

During this period, the basic form of the design of steam lorries was established, though not without some exceptions. The Liquid Fuel Eng. Co. Ltd's entry in the Liverpool trials of 1898 sported an oil-fired boiler, and to claim its second prize of £75, had been transported all the way from the Isle of Wight.

It may seem strange that oil firing was not pursued – even the Leyland people only used it once, discarding the idea in favour of solid fuels. However, apart from the fact that the burners and other equipment were not so efficient as solid fuel counterparts, the availability of cheap and plentiful supplies of home-produced coal and coke weighed heavily against its use.

Looking at the design and construction of these steam lorries in some detail reveals a few quite ingenious arrangements. There were two basic types, the overtyp and the undertyp, which in simplistic terms refers to the position of the engine relative to the boiler, and the overtyp arrangement was pioneered by Foden of Sandbach. The undertyp, typified

PHOTO 06:

The overtyp pioneer was Foden, and this view is typical of the design, pictured by the author at the Cumbria Steam Gathering at Kendal in the 1980s.

PHOTO 07:

A Clayton & Shuttleworth steam wagon with unusual forged steel wheels. A Brass Clayton emblem on chimney finishes it off.

PHOTO 08:

This extract from an engraving highlights the change-speed gear fitted to a Clayton overtyp steam engine.

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by the products of Sentinel Waggon Works and Leyland (formerly the Lancashire Steam Motor Co. Ltd) placed the engine below the vehicle body, with the boiler up front and often across the cab.

The Lancashire Steam Motor Co's 4-tonner of 1898 weighed in at just under the maximum three tons unladen weight to comply with existing regulations concerning size and operation. It was equipped with an oil-fired boiler (surprise, surprise!), supplying steam to an engine mounted under the load platform behind the 'cab'.

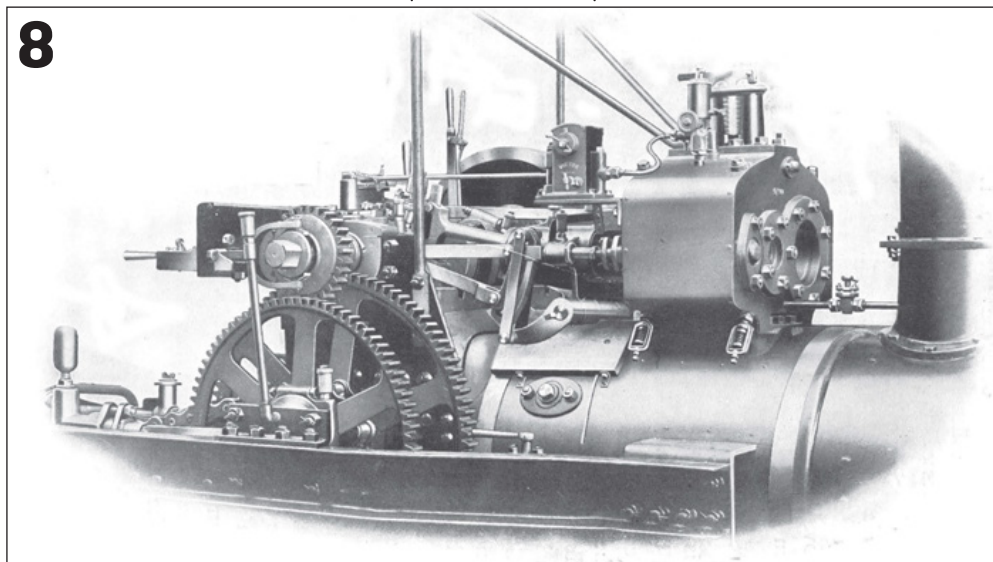
The vertical boiler was mounted in front of the leading axle and consisted of a one-piece cylindrical outer shell at the top of which was a domed tubeplate and through which passed almost two hundred copper tubes to the firebox at the base of the assembly. The burner, contained in the firebox, was described as being of the 'fairground' type.

Foden's first steam lorry appeared in 1900 and could be said to have pioneered the overtyp design. With the engine above the boiler, this used a two or three-speed transmission with sliding gears between crankshaft and countershaft, final drive by a lengthy roller chain and centre-pivot, or

Ackermann stub-axle, steering. With the smokebox end of the boiler extending in front of the driving position, surmounted by a large chimney, it looked more like a road-going railway engine.

The first four Lancashire Steam Wagon products featured 'cart-type wheels', with open spokes and were similar to agricultural wagons. By the time the Class B arrived at the turn of the century, these had been replaced by wheels with steel plates bolted over to form a hub, with polished hub caps.

In 1900, the people from Leyland successfully changed from oil to coke as a fuel for their boilers, following delivery of the firm's final oil-fired vehicle design, which included vans supplied to the Royal Mail, Ceylon, along with wagons for the Ceylon Rapid Transit Company. The Class B wagon was then in production, with a 4-5 ton payload – it had a vertical boiler ahead of the leading axle, steam engine and transmission under the wooden load platform and the water tank under the rear overhang behind the trailing or driving axle. Effectively it was the classic undertyp steam wagon – but it was noted by later researchers that the way the structure was built, it would have been virtually impossible to meet the then maximum 3 tons unladen weight

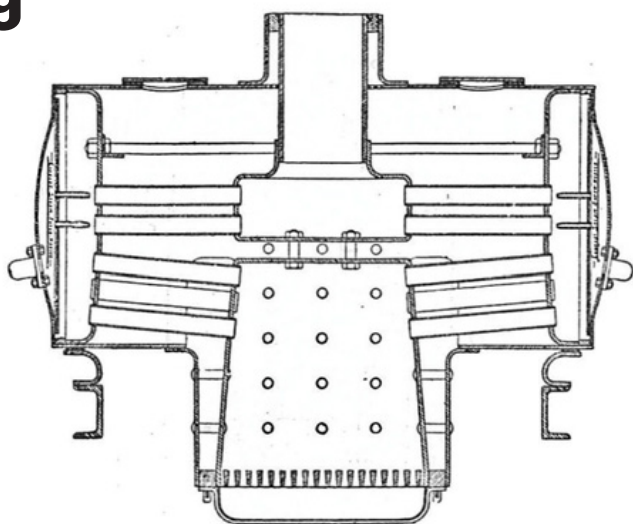
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Compound interest

The engine was a relatively common type – at least to many steam road wagons – and described as a compound link reversing engine, slung from the main chassis longitudinally below the load platform and between the front and rear axles. The final drive to the road wheels was made through Renolds roller chains on either side of the wagon.

One high pressure and one low pressure cylinder – 3½-inch and 6¼-inch diameter with a common stroke of 6 inches – were arranged to drive spur gearing attached to the crankshaft, in turn engaging a set of spur gears on a second motion shaft and finally, via a compensating gear

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shaft, to the roller chains attached to the road wheels.

Crew facilities were spartan, although in some early examples, such as the Thornycroft No.1 from 1896, drivers and their assistants were provided with a luxurious cab, having not only a roof (no windscreen of course) but a backplate and even a seat! Later still, on undertypes, the front of the wagon 'cab' was completed by a 'wrap around' front, or apron.

Following further changes to the Road Traffic Acts in 1903 and 1904, maximum unladen weights were increased, and the coke-fired Class B was superseded by the Class H, which was able to take advantage of the new limit of 5 tons unladen.

The Thornycroft Steam Wagon Co, one of the Lancashire Co's most serious rivals, constructed its under-type wagons along similar lines. Thornycroft's 4-ton wagon used a vertical water-tube boiler with a working pressure of 200psi, whereas in the larger 5 tonners a locomotive-type horizontal boiler was used which gave this particular design the general appearance, from the front at least, of a traction engine.

Judging by some contemporary illustrations, these particular wagons came with and without roofs for the crew – a kind of limousine and sports version! It maybe is worth pointing out the rather obvious comparison with modern combustion-engined vehicles, with the engine and driving positions mounted close to the leading (steering) axle, an enclosed cab and the transmission shafts driving the road wheels of the rear fixed axle through a system of gearing. Behind the cab of course we have come to recognise an almost infinite variety of loading platforms, covered vans, tippers and many more.

The two decades between 1900 and 1920 really marked the zenith of

PHOTO 09:

Curious design by the Yorkshire Steam Wagon Co – horizontal layout to avoid 'tilt' problems climbing hills. The firebox was in the middle.

PHOTO 10:

Yorkshire Engine under-type built in 1905. The horizontal boiler design remained essentially unique.

PHOTO 11:

Alley & MacLellan earliest 'Sentinel' steam wagon of 1906. Boiler is at very front here, and cart-type wheels are fitted.

steam road wagon building, including some innovative designs produced during the First World War, but of course, oil or petrol engines were beginning to make major advances commercially. Principal steam builders at this time were:

- 1) Bristol Wagon & Carriage Works Ltd – this firm built steam wagons from 1904 to 1908
- 2) Straker Steam Vehicle Co. Ltd, Bristol and London
- 3) Clayton & Shuttleworth Ltd (later Clayton Wagons), Lincoln
- 4) Foden Ltd, Sandbach, Cheshire
- 5) Lancashire Steam Motor Co, Leyland, Lancashire, became Leyland Motors Ltd after 1907
- 6) T. Coulthard & Co. Ltd, Preston, Lancashire (absorbed into Leyland Motors from 1907)
- 7) Mann's Steam Cart & Wagon Co. Ltd, Leeds, Yorkshire
- 8) Sentinel Wagon Works, Shrewsbury, Shropshire
- 9) Steam Carriage and Wagon Co. (later Thornycroft Steam Wagon Co.

Ltd), Chiswick & Basingstoke
10) Yorkshire Steam Wagon Co. Ltd, Leeds, Yorkshire

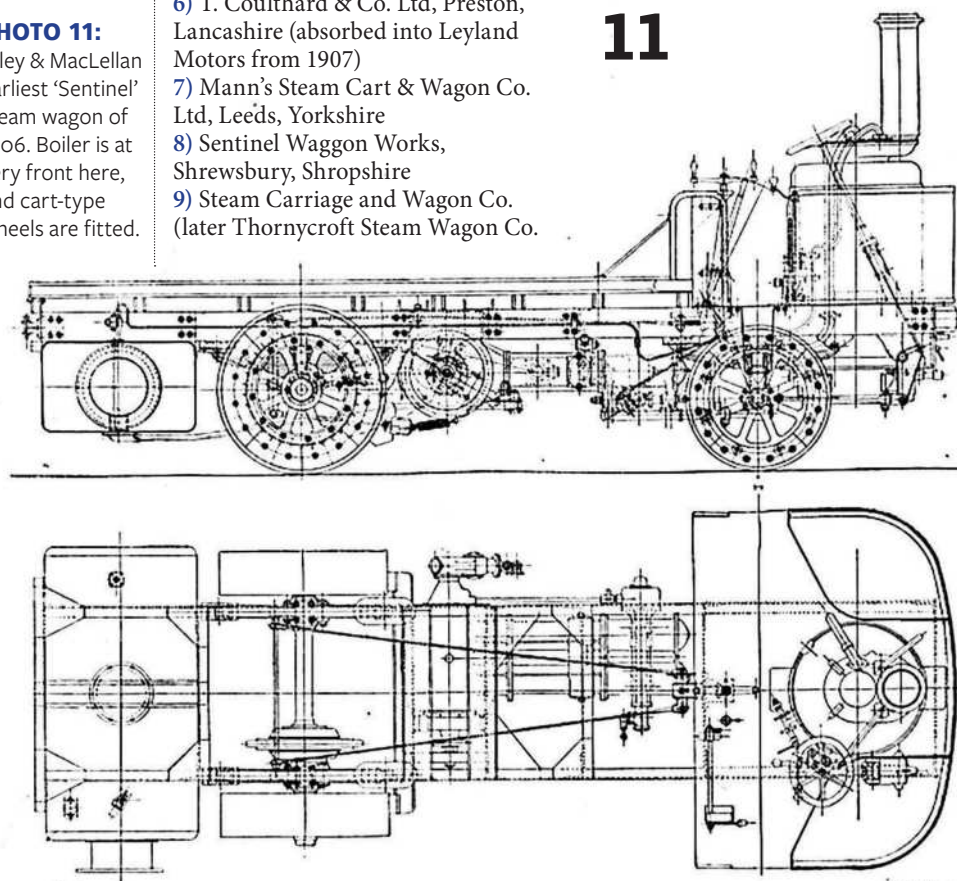
Some started with steam and attempted to make the transition to petrol or oil-engined traction, but it was only Leyland, Foden, Thornycroft and Sentinel that would prove successful in the next stages for commercial road transport.

The Sentinel Wagon Works was also one of the most well-known and successful builders of the under-type steam wagon builders, between 1906 and 1923. The firm actually began life as Alley & MacLellan in Glasgow, and by 1880 was busy with the development and production of

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high-speed engines for electricity generation and marine applications.

Turning to road transport, the firm's first 'Sentinel' steam waggons were the Model 6 Ton Flat and Model 5 Ton Tipper, which were powered by a two-cylinder double-acting engine mounted beneath the flat bed of the lorry. The vertical boiler was mounted at the front of the crew position, 'protected' by a simple apron, with the driving position immediately behind, and steering was by the Ackerman system. The final drive followed the Leyland and Foden pattern, using commercially available chain drives, along with solid rubber tyres to their steel straked or wooden 'felloe' wheels.

In 1906 Alley & MacLellan took over the development work on steam waggons started by Simpson & Bibby in Manchester, and formally established the Sentinel Steam Waggon company, operating from Glasgow until after the First World War when most of the workforce was transferred to a new Sentinel factory established on the outskirts of Shrewsbury in Shropshire. By 1923,

Sentinel had built some 4,500 of its 'Standard' road wagons – not bad for a late entry into the field.

The new Shrewsbury factory was designed and built to follow the mass production techniques and practices introduced by Henry Ford in the USA. From 1923 onwards, the 'Sentinel Super' was built, and this became Sentinel's top seller of the undertype designs until around 1934. An interesting innovation with the Super Sentinel was the inclusion of the company's own patented differential built into the engine crankshaft.

A major difference between the Leyland and Thornycroft wagon builders lay in the design of their transmission systems. Where Leyland was content to use a commercially available chain drive, Thornycroft devised its own patented gearing system and a spring drive. Thornycroft's specially designed radial valve gear was housed, including cranks, within a dust-proof, oil-tight casing – lubrication was used the 'splash' system. The Lancashire Steam Motor Co, along with several others

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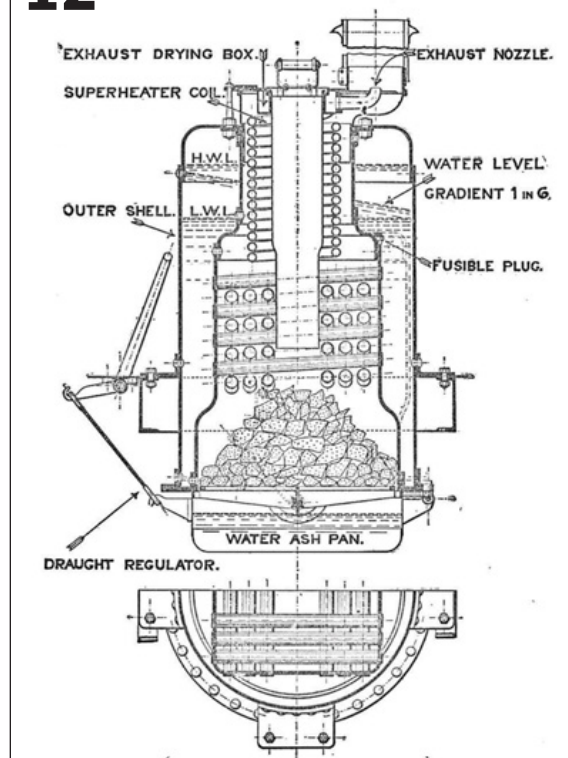


PHOTO 12:

Detailed diagram of Sentinel boiler shows the arrangement of smoke tubes, with different rows at 90 degrees to each other. Note use of a superheater, adopted around the same time on railways.

enclosed its valve gears and other working parts in similar assemblies.

Other interesting examples of steam road wagons were those designed and built by T. Coulthard & Co. of Preston, which later became part of Leyland Motors. This firm had experimented in the early 1890s with several types including wagons with compound engines, uni-directional engines and oil-fired boilers.

Compound interest

Not content with these particular complexities, Coulthard then tried uni-directional and reversing triple expansion engines, followed finally by the firm's most favoured arrangement, the compound reversing engine for the more modern designs of 1898 onwards. Coulthard placed both boiler and engine between the two axles; the former being a vertical solid fuel fired design. Of the companies listed above The Straker Steam Vehicle Co., Mann's Steam Wagon Co., and Fodens Ltd used a similar layout – theirs were much more like traction engines with horizontal, locomotive-type boilers.

Certain characteristics of the design of steam wagons were common to all – at least in general arrangement – including wheels, brakes, steering and suspension. According to one contemporary designer the existing regulations restrictions on width to an overall maximum of 7 feet 6 inches, required the use of smaller wheels than would otherwise have been employed. Even so, with the loading platform overhanging the wheels on

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PHOTO 13:

Sentinel two-axle s4 lorry at the Cumbria Steam Gathering in the 1980s, more than 50 years old and well restored. Photo: author

PHOTO 14:

Final evolution of the steam road wagon – a Sentinel S6 tipper from 1933, with pneumatic tyres and a luxurious cab. Smoke from the chimney can just be seen at the back of the cab roof.

the rear axle, they were on average from 3ft 3in to 4ft in diameter.

The front wheels were often smaller and used for steering. With solid tyres around various designs of steel wheel centres, some resilience was provided by using either wooden spokes or inserts to provide the cushioning effect.

The most common types of wheel were the 'gun-carriage' pattern and 'Felloes' wheels, with other patent designs including 'Spurrier's Composite Wheel' used by the Leyland company and, less frequently, a wholly riveted and bolted steel plate wheel. A curious departure from normal spoked wheels was the 'Gare Patent Resilient Wheel', which used a patchwork quilt-like assembly of wedge-shaped wooden blocks in its solid structure.

Good brakes were clearly essential, bearing in mind the operating areas of these wagons, though it is difficult to imagine they being of great help on the 1 in 10 gradient of a wet cobbled street with wooden, solid rubber-tyred 3-ton wagons. In the main, the brake shoes were hung outside the wheels of the vehicle, pressing on the treads in the same way as railway brakes.

Drum role

An alternative system developed by the Lancashire Steam Motor Co. was the forerunner of the modern drum brake. In this design internally expanding hardwood shoes applied the braking force to the inside, enclosed and dry surfaces of the brake drums but were mechanically, rather than hydraulically controlled.

Steering methods were typically the 'Ackerman' system in which two arms attached to the road wheels allow these to move independently of the axle, while a second shaft connected between the wheels maintains each of the road wheels in parallel tracks. Whatever the merits and demerits of composite over gun-carriage wheels, early 20th century 'heavy goods' vehicles were distinctly hard riding with none of the refinements of 21st century suspension – simple leaf springs were the order of the day.

By the end of the first decade of the 20th century and after some varied beginnings, the shape of commercial road transport was becoming apparent and, not surprisingly, ever more regulation was being enacted. There were various 'Locomotive Acts', in 1861, 1871, 1896 and 1898, but by 1903 this had changed to 'The Motor Car Act' – perhaps reflecting the increasing and expected dominance of internal-combustion engined vehicles, and the end of the road for steam. **EIM**

Broaching the subject

Harry shows how to make multiple identical keyways.

BY HARRY BILLMORE

With a need to make four identical keyways in the cranks of the Fairbourne Railway's 6-inch scale Darjeeling B-class loco, 'Sherpa', I decided that it would be easiest and quickest to broach them.

This is a process where a tool that looks like a wide chunky saw blade is pressed through the work-piece taking out material – it is then advanced using a shim and put through again, taking out the amount of material the thickness of the shim.

The tool does this by being tapered from its base to the top of the teeth, so that the top teeth stick out further from the back of the tool than the bottom teeth. When pressed through this provides a very consistent and controllable cut.

Tight fit

I bought the right-sized broach (10mm in this case) then set about machining the guide for it – this is simply a top hat that is a snug fit in the bore of the workpiece, with a slot cut in it that is a tight sliding fit for the width of the broach, while being deep enough so that the first pass starts a few teeth up the broach.

I measured the thickness of the broach at the third tooth and then made the slot to that depth.

Once the guide is machined, the workpiece is put into the press, either an arbour press, or in my case a hydraulic press, and the broach is inserted into the guide and pressed through – this will start the keyway.

A shim is then added between the back of the broach and the guide and is then pressed through again, this advances the keyway the thickness of the shim. Repeat until your arms fall off from tiredness or the keyway is the correct depth. **EIM**

Photos by the author



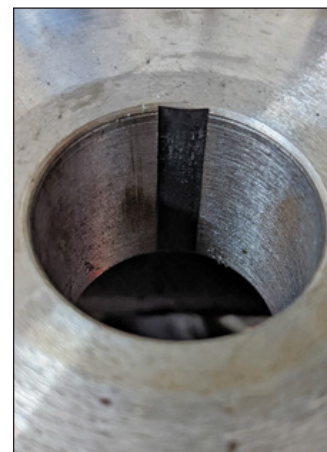
1) The broach sitting on the crank blank. Note the taper as the teeth go up the broach.



2) Different view of the broach, the small lines in the teeth are to help the chip break off.



3) Machining the broach guide, a simple turning job before using an end mill to cut a slot – a tight sliding fit for the broach. Depth of slot is important for the first pass.



4) The keyway after the first pass, note that it is the full width of the keyway with no gap in the middle, this gives a good reference point to measure from.



5) The broach part way through a pass, with 2 x 1.5mm shims added – this is the amount of material removed in each pass.



6) Broach, broach guide, shims and crank blank with a perfect keyway cut into it. Also shown are the chips that the broach cuts.

Restoring a Gauge 1 Midland Compound

Anthony's restoration of a Gauge 1 locomotive employing many workshop techniques continues, this month seeing work on the tender completed with some vital details.

BY ANTHONY WHITE Part Four of a short series

Having described my rebuild of the loco's sad-looking tender over the past couple of issues, I tackled the final details, first replacing the bars under the axleboxes that go on the outer frames. Originally these were glued on and dropped off while stripping the paint – they are purely cosmetic and I preferred to solder them – they would be more secure and soldering here is relatively stress-free as they can be easily held in position.

After cleaning and tinning them I held them in position with a cut-down aluminium hair grip, useful for many soldering jobs, and sweated them on.

Photo 24 shows all three stages, the left tinned and loose but not yet in correct position, the centre held for soldering with hair grip and at right the result. This was the opportunity to correct the spacing and alignment of the axlebox and spring castings also but I had to do a little filing of the lower edge of the frames to sort that.

Two of the handrails were loose at one end and had been bent out of shape during previous handling but were quickly straightened and fixed. I placed thick card spacers under the rails to hold them at correct spacing from the body side – a touch of a very hot iron with some flux at the base of the handrail knobs re-fixed them.

I was now getting towards the end of the list of repairs but a couple of brass strips were needed to hold the interior coal plate in position below the coal side sheets. The coal plate is made of plastic card, or a thin piece of wood would do, as I planned to put the receiver in the tender and didn't want to use an external aerial so I was avoiding enclosing the radio in a complete metal box.

The dummy coal that was to sit

here was made much later but is essentially a rectangle of plastic card with broken-up real steam coal glued in place with Super-Glue or PVA wood glue, the former is quicker. I placed a few strategic pieces around the outer edges and once these were dry and set I piled more coal in the centre and dropped diluted white glue onto them.

It's worth having a sheet of plastic film under and around your piece to stop the glue flowing out everywhere. And once it's all hardened it's worth filing the edges so that the 'block' of coal fits easily and removes smoothly from its position as you don't want it taking the black paint off the interior of the coal sheets every time you set up and finish a run while accessing the main switch and charging socket.

Accuracy or ease?

Replacing the missing main side steps required another decision as to whether to replace all four with the correct detail or just make the two missing ones identical to the remaining two. Initially I decided on the latter and found some scraps of nickel silver of suitable size, but when I looked at the works drawing in *LMS Locomotive Profiles No. 13: The Standard Compounds*, I realised that the original model steps were only half the correct depth, not wide enough and with incorrect rivet detail. Plus they were not set back correctly.

I therefore removed the two remaining steps and made four new main backing pieces from 0.5mm (correct thickness) nickel silver of 30 x 22.5mm size, filed to shape.

Deciding on the design and style of the steps themselves proved a problem. The surviving two had treads slightly too shallow in depth but the ends were



"A touch of a very hot iron with some flux at the base of the handrail knobs re-fixed them..."

PHOTO 24: Soldering the bars under the (yet to be fitted) axle box and spring castings.

All photos by the author

turned up at a right angle and I could find no photos of Compounds to match that style. A few had a hint of a curved upturn at the edges, many had the corners slightly upturned but mostly they were plain and flat.

In the end I went for the simple plain version, the style on the photos I was working to on the prototype loco. I simply cut and bent the steps and added the rivet detail before soldering them on to the back pieces.

With all the dimensions correct and full rivet detail on the four new steps (two front, two rear), I soldered a length of brass angle at the rear and along the top edges in order to make the top soldered joint more secure.

When they were finally cleaned and completed I put the set to one side, planning to solder them in place later when the buffer beam and front buffing beam were finally fixed – they need to fit snugly in the angles between these and the running plate.

Placing the electrics

I've mentioned the main switch and charging point was mounted inside the tender – I've always found this to be the best place for it and as it's a major fitting job I couldn't put it off much longer. I was initially tempted to put it in the tender water dome and I did remove the dome and do some test measurements, but a standard sub-miniature switch would have protruded too far into the space below where I planned to fit the main battery pack – the usual miniature switch and charging socket would not have both fitted here.

It would have been possible to use alternative smaller items but I decided against losing any space underneath. I therefore made a bracket to take both items, soldered in place in the tender as shown in Photo 25. Why not in the corner? Because it was positioned to sit between the wheels whose flanges rise



up through six slots and intrude above the tender interior (the chassis with wheels is not yet fitted to the tender in the photo) to gain maximum available height. This allowed the battery to be fitted under the rear of the tender top leaving plenty of space for the other three items, the Electronic Speed Control (ESC), Sound Card (SC) and Radio Receiver (Rx), all easily accessed under the cosmetic coal lift-out section.

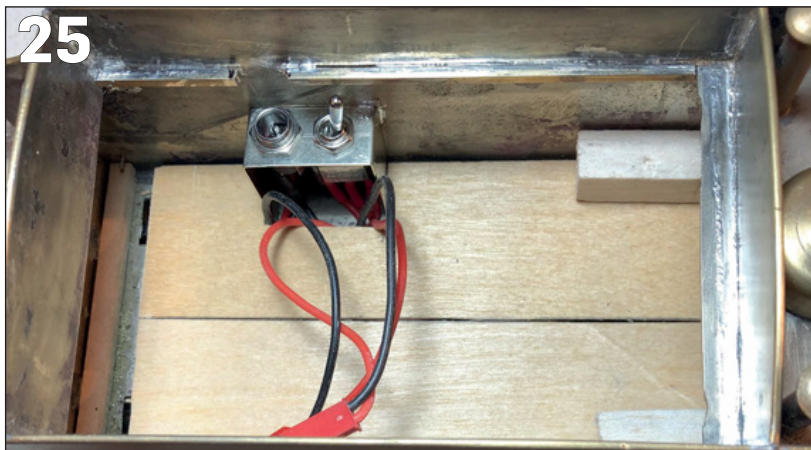
I always think it's a good idea with the inside of the tender full of electrics and electronics for it to be lined with insulated material – card, plastic or wood as many of the printed circuit boards in the electronics have exposed wires and terminals.

I made the floor from a scrap of 1.5mm ply, in two longitudinal pieces for ease of insertion and removal. In fact I couldn't get it in as one piece, resting on six cross-struts of 5mm square obechi to give good clearance for the wheel flanges. There is a need for a slight cut-out of one side insulating piece to go around the main switch and charging socket and I later added some thick balsa strips to gently hold the battery from sliding about when fitted. I doubt they were essential and a few pieces of foam rubber would have sufficed. At this stage none of the interior insulating materials were fixed although I did later glue them in position.

The final layout of the electronics would be decided when I had them to hand but essentially the AA battery pack goes to the rear under the dome and against the back wall of the tender, the ESC and SC fit low down and forward while the Rx will best go just under the plastic coal plate so as to easily receive radio transmissions and so that the synchronising LED will easily be visible when the coal is lifted out when I prepare for a run.

The water dome, I discovered, was an wrongly-sized fitting. A whitemetal casting now needed replacing and I was pleased to do this as I discovered it was also slightly in the wrong position and off centre. I also decided to bolt it on and silver soldered a 4BA

"A whitemetal casting now needed replacing – I discovered it was also slightly in the wrong position and off centre..."



brass screw in the centre underneath, carefully marking the centre of its correct position and drilling it 3.5mm and refitting it as shown in the photos.

I put the brass 4BA nut on top of the tender (Photo 26), rather than more obviously underneath as this ensured there was no protuberance underneath to interfere with sliding the battery in or possibly damaging the battery covering.

More buffer issues

For some reason I had again to remove and face replacing the rear buffer beam – I'd lost track of the times I'd done this and it made me think once more about the advantages of having it bolted or screwed. Painting the beam a different colour to the bodywork would be much easier while all the extras could be added more easily and painted more easily when it is not part of the bodywork. I finally convinced myself and made up a couple of brass L brackets (Photo 27).

You can see in this picture how the brass filler pieces cover the gap in the outer frames soldered to the rear of the beam either side, but also how the new rear-of-buffer design with the absence of a 2BA nut and the rear 6BA nut reduced to 8BA has made it all fit neatly within the outer frames.

In addition to making painting easier this considerably eased the soldering of the rear steps as there's not a lot of room behind them – I was now able to introduce a small

soldering iron in from behind while the buffer beam was off the loco.

Making the vacuum pipe could be delayed no longer – I used what bits I had in a scrap box for the angled top and some spring for the corrugated tube, together with some 2mm brass tube for the main lower part and fabricated it all to match. Photos and drawings of this detail such as exist seem unrealistically skinny and do not show much detail or dimensions, but I ended up with the result visible in Photo 28. This shows the fabricated vac pipe – the corrugated part, a wire spring, will be fitted after painting. The coupling and most of the other rear tender detail was now completed.

I had been putting off replacing the whitemetal axlebox and spring castings as they all needed a lot of cleaning from old paint and glue, plus fettling to smooth out some of the casting imperfections.

Normally I would float them onto the outer chassis on some low-melt solder but for a number of reasons on this model I just used epoxy glue, mainly as I needed time to be able to easily adjust their position. I only did one side at a time, leaving them 24 hours each time to cure.

On one side it was difficult to get them flat on the chassis as the axle holes as originally drilled seemed to have somewhat bowed the metal – I couldn't make it flat again, so I had to laboriously scrape away some of the whitemetal from the backs of the

PHOTO 25:

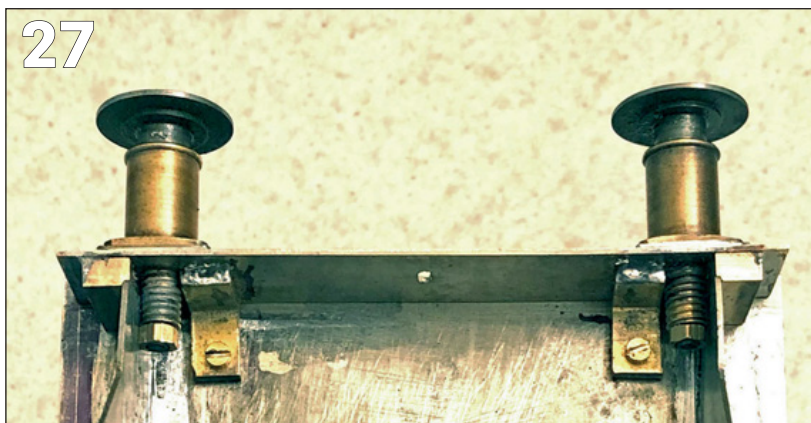
The main switch and battery charging socket in position in the tender.

PHOTO 26:

The fitting of the new water dome.

PHOTO 27:

The buffer beam once it had been re-made as a fitting to be screwed on.



castings, but eventually everything seemed to settle reasonably. It is important to ensure that the spring hangers are symmetrical in relation to the big holes in the frame particularly if you plan on lining the paintwork. These can also be seen in Photos 20 (printed last month) and 28.

Conflicting information

Replacing the remade main steps had also been put off as there were a number of queries that I hadn't been able to resolve with regard to positioning. Drawings vary in how far they are set back, some suggesting they protrude no further than the running plate, and some (the works drawings) suggesting, and confirmed by photographs, that the front and rear steps are set back by different amounts. I ended up with the front set back about 4mm from the edge and the rear only 2mm which roughly followed the works drawings.

Both front and rear steps sit on a short length of U-brass to hold the backs at the correct distance from the outer frame – the front is soldered in position all the way around as the front buffing beam is already soldered to the bodywork.

PHOTO 28:

The finished refurbished tender with vacuum pipe, its corrugated part to be fitted after painting.

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

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The rear has the removable buffer beam so it is only soldered by the aforementioned U-piece behind and along its top edge, although one could solder the rear buffer beam in position and repeat as for the front pair.

Photos 28 and 20 show the front, rear and each side finally completed before painting although the coupling is not yet fitted and the vac and steam

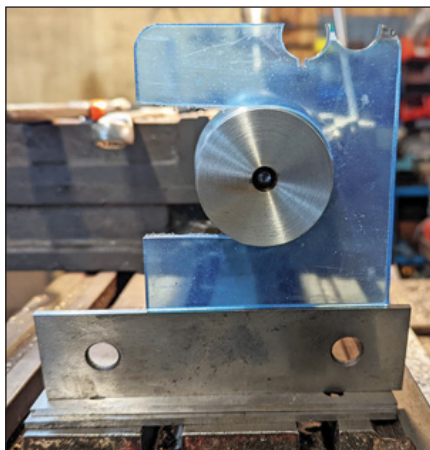
pipes still need to have the flexible corrugated pipes attached, (all to be done after painting). Also of course the two rear etched plates, they would also be glued on after painting, but all the parts were made, tested and ready to go on as a final job together with the loco plates when the fully painted model was ready. Now I could move onto the loco itself. **EIM**

MORE BENCH TALK

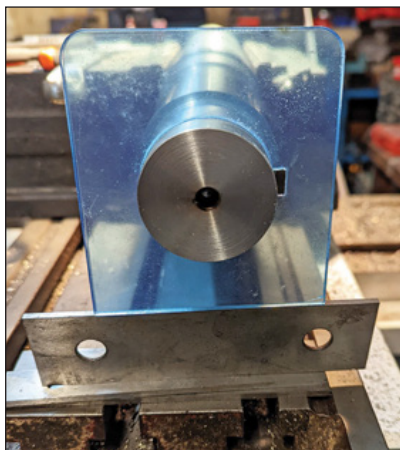
Laser guided...

Harry employs a laser-cutter to aid him with accurate wheel-quartering.

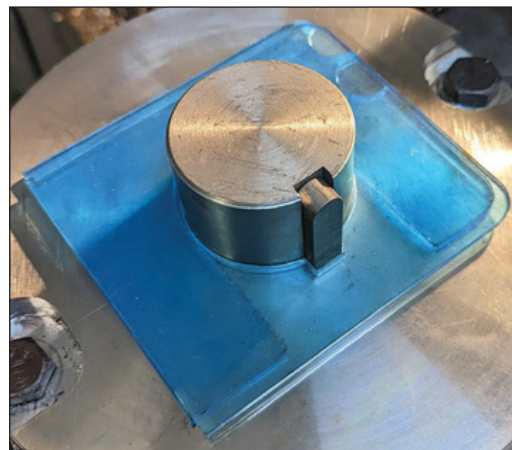
BY HARRY BILLMORE



The first guide Harry used to initially set up the axle – there is a tab that engages into the keyway and the bottom edge is parallel with the centreline of the key.



Using the second guide to double check the orientation, note the parallels under the bottom edge. Harry also forgot to put the key in for the photo, "it should be there".



Using the second guide, this time having remembered to fit the key for the photo. Harry used an edge finder in the guide to make sure the fixture was set perfectly on the mill.

One of the problems of making new axles is ensuring the quartering of the cranks or the wheels is correct. There are numerous ways of doing this, but this is how I have done it most recently.

I have a cheap £300 laser cutter that I mainly use for prototyping 16mm to the foot

models, but it can come in handy for other things. For the quartering of the axles on the Fairbourne Railway's 6-inch scale Darjeeling loco 'Sherpa', I drew up a couple of guides, one that engaged directly with the keyway in the axle, and the other that engaged on the key on the axle. Both guides had an edge

that was exactly parallel to the centreline of the keyway.

Having cut them out in 3mm acrylic, it was easy to use parallels to ensure that the axles were correctly quartered. I also used them to align the fixture for drilling the crankpin holes in the cranks later on. **EIM**

A freelance traction engine in 3-inch scale

Jan-Eric's traction engine build project, designed for passenger hauling rather than following a prototype, this month turns to fabrication of the cylinder – and plastic pistons....

BY JAN-ERIC NYSTRÖM Part Ten of a series

The cylinder with its valve chest is of course the most important part in any steam engine. I have always made my cylinders of corrosion-resistant materials, despite the fact that cast iron is a very common material, especially for models available in kit form, or at least as a set of castings. Sometimes, cast bronze cylinders are also available, but at a significantly higher cost. Since I didn't use any castings for my project, I decided to fabricate the cylinder and valve from several parts.

My preferred cylinder material is bronze, which is more corrosion resistant than brass, since it contains none, or very little zinc. Zinc is a major part of ordinary brass alloys, usually around 35-40 per cent, and in hot water, it can dissolve out of the brass, making it porous and brittle – this, however, does take a very long time of constant use, but it is not unheard of in hot-water piping.

Photo 97 shows two pieces of bearing bronze, leftovers from my earlier locomotive projects. This particular alloy has a composition of '85-5-5-5' percentages of copper-zinc-tin-lead. It is also known as 'gun metal' among live-steam hobbyists.

The machining was started with the valve cylinder – yes, cylinder, even though very few traction engines had piston valves; most of them used old-fashioned slide valves. The positive experience gained from my two piston-valve live steam locomotives motivated me to depart from the common practice. I will of

course later shroud this unorthodox construction in a cowl representing a normal slide-valve chest.

I turned and milled locomotive-type steam openings in the valve cylinder, and added steam-channel collars around them by silver soldering. In **Photo 98** I'm machining this assembly to fit the main cylinder exactly, in order for the two cylinders to be silver soldered together.

Photo 99 shows the method used to insure proper capillary penetration of the silver solder: note the nicks in the smaller cylinder, made with a tiny triangular file, and the ten punch marks on the flat surfaces milled on the main cylinder.

The punch marks, with their edges slightly rising above the surface, will facilitate silver solder penetration by ensuring that a narrow space (a few thou) remains between the parts for the flux and solder to run into. Make too large a space, and the solder won't run all the way and fill the interstice completely – which is absolutely necessary to provide steam-tight joining of the parts.

The main cylinder has steam-way depressions milled into its side, but I had to be careful not to mill too deep and break into the cylinder bore, while still maximising the area of the steam-ways. There isn't much sense in having large steam passages in the valve cylinder, if the steam is constricted later, on its way to do work on the piston! Such a situation is called 'wire-drawing', and severely limits the power of a steam engine.



PHOTO 97:

Two pieces of bearing bronze to make valve and main cylinders.

PHOTO 98:

Silver-soldered valve cylinder on mill table. Collars protrude from cylinder, thus it is clamped on V-blocks at the ends only.

PHOTO 99:

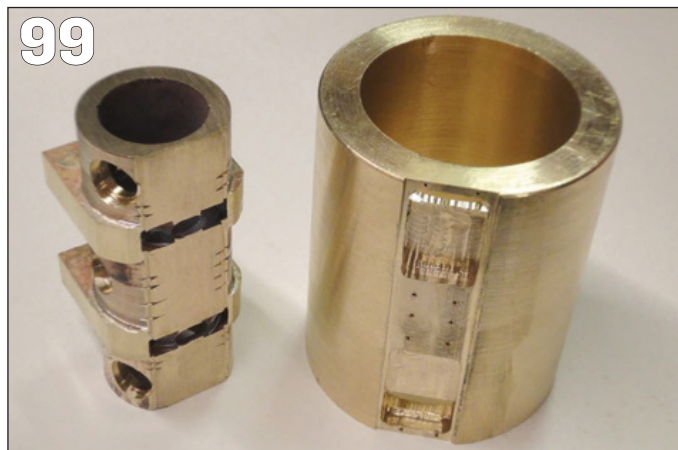
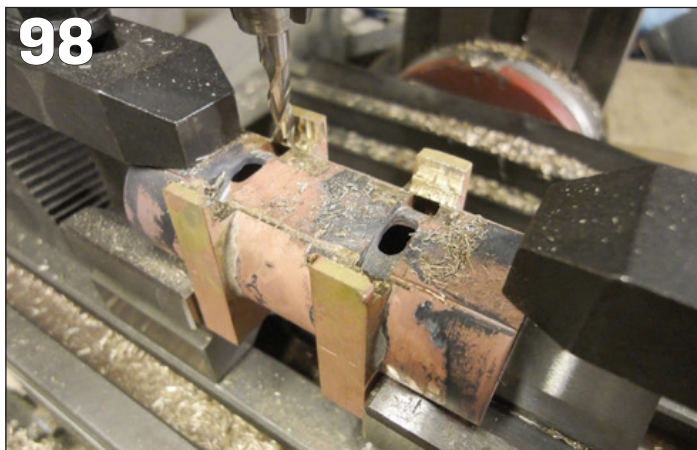
Valve cylinder is cleaned up, the main cylinder has milled steam ways. Note the filed nicks and punch marks, facilitating solder penetration.

All photos by the author

Slightly scary soldering

In **Photo 100**, I have positioned all the parts in preparation for the silver-soldering operation. I have not attached them to each other in any way, except for the three short steam entry and exit tubes made of hex brass, which are threaded into the valve cylinder at right.

The main cylinder is placed loosely upon the jaws of the bench vice – it must not be clamped; that would distort it badly when it expands while being heated to soldering temperature! Maybe I took a risk in trusting only gravity to retain the pieces in position, but I was lucky; **Photo 101** shows the



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assembly after pickling in 10 per cent sulphuric acid (one part of battery-strength acid poured into two parts of water). There is the inevitable run of silver solder, but not too much, and it will all be concealed behind the cylinder lagging, anyway.

After silver soldering, all surfaces are covered with oxide. Most of it is of course removed by the pickle bath, but the inside surfaces of the cylinders need to be finished to almost mirror-like smoothness. My local auto parts store stocked hones for both moped and car cylinders, and they were perfect for the task! **Photo 102** shows the honing of the small valve cylinder (just under an inch in diameter); the hone shaft is attached to my cordless drill, which I'm running at top speed, having first lubricated the honing stones and cylinder wall with plenty of cutting oil.

Photo 103 shows the larger hone just entering the main cylinder (a tad under 2 inches in inside diameter), which was ground smooth in the same way. In **Photo 104** you can see the nice finish that can be accomplished with such a simple, inexpensive tool. The whole operation took less than ten minutes per cylinder, taking care to add oil whenever the friction between hone and cylinder grew noticeably.

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**PHOTO 100:**

Parts loosely placed upon one another, relying on gravity to keep them in place during soldering. Slightly scary...

PHOTO 101:

After pickling, soldered assembly can be inspected for leaks in joins. Fortunately, none found (yet...).

PHOTO 102:

Small hone for moped cylinders perfect for honing valve cylinder bore, just less than an inch diameter.

PHOTO 103:

Larger, three-stone hone used to smooth main cylinder. Slight modification needed to fit in slightly under two-inch bore

Piston and valve rods

Continuing the principle of non-corrosive parts, I made the piston and valve rods of stainless steel. It is a material much more difficult to machine than ordinary 'rusting' steel – it is especially bothersome to do any threading on it.

I always machine the stainless rod ends to a dimension slightly under that specified on threading charts, but nevertheless, the rod always tended to slip in the chuck, causing it to be badly scored by the jaws. The solution was simple: I drilled a small hole in the end of the rod, in a position that will not be seen, nor in contact with any O-ring or gland, and then I pressed a roll-pin into the hole. The pin will rest against one of the chuck jaws, see **Photo 105** – this prevents the rod from slipping in the chuck. The pin is easily punched out of the hole when the thread is finished.

The threading is done manually; I open the cover on the lathe (revealing the change-wheels) and can turn the mandrel's large belt pulley by hand. Note how I hold the threading die in a small chuck in the tailstock – the indentation on the outside of the die is gripped by one of the chuck jaws and thus prevents it from rotating in the chuck. The small chuck is held by its

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'pin wrench' resting on the lathe cross slide, while still letting it move horizontally; the Morse shank is sliding loosely in the tail stock! I took care to start the thread properly centred and aligned, of course.

In **Photo 106**, I'm turning the piston-valve gland, made from two pieces of brass, one circular, the other hex. The larger, circular piece was first turned to leave a shallow spigot, then parted off and silver soldered to a hex piece of smaller diameter. In this way, I saved a lot of the more expensive, larger diameter, round brass bar.

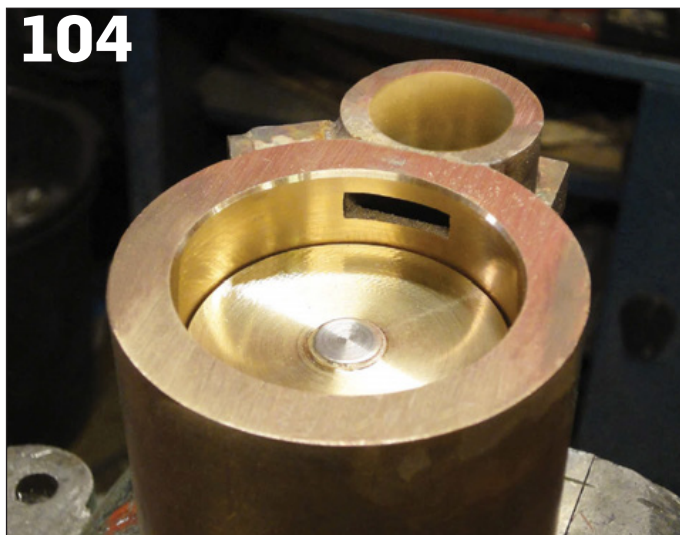
Note that I'm using the revolving centre in the tailstock to hold the piece securely pressed into the chuck; with such a small spigot on the chucked end of the part, it could easily be ripped out of the chuck without this precaution.

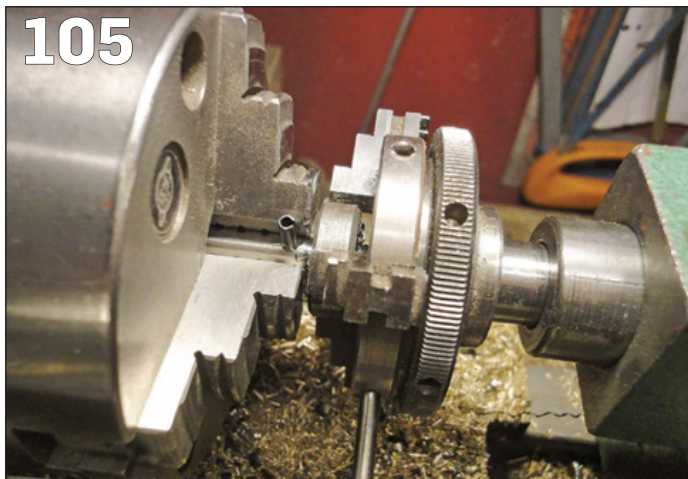
Photo 107 shows the cylinder assembly, with covers and glands, as well as the piston and valve rods. The construction of the piston is very simple: just as in my locos, I have made it from a 10mm (0.4-inch) thick piece of brass plate, with a turned groove accepting an O-ring and a strip of 2mm thick PTFE (Teflon) wound on top of the O-ring, the latter functioning just as a normal piston ring would.

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Note the Z-shaped cut-out that enables the piston ring to expand when hot – PTFE has a thermal expansion coefficient about six times larger than the metals used, and thus need some expansion space. The O-ring under the strip provides the slight but necessary pressure against the cylinder wall, while the PTFE material ensures smooth gliding of the piston, requiring only infrequent lubrication, if at all – PTFE is, in fact, a self-lubricating material!

The valve spindle consists of two PTFE rings carefully turned to the right diameter and thickness, a brass ring silver-soldered to the rod, a spacer spool turned from hex brass, and finally, a brass nut on the end. By shortening the spacer, or inserting brass shims between it and the PTFE rings, the distance between them can later be adjusted, if necessary. The rings are turned to a slightly loose fit in the valve cylinder; their expansion at steam temperature will make them seal well.

Crosshead and guides

Most British traction engines have distinctive tubular crosshead guides, so of course I wanted to imitate that, again without using a casting. In my scrap box, I happened to have a tube of exactly the correct diameter – lucky, right? Not really, since it was very hard, stainless steel, difficult to drill or mill.

Knowing the problems I had experienced in just machining a circular hole in the stainless tube I used for the smokebox (described in an earlier article), I was loath to even try making the oval-shaped openings in the sides of the guide tube by drilling and milling, so again, as I've done time after time, I reached for my trusty angle grinder... As ever, angle grinder engineering is not recommended for perfectionists and you must take all the safety precautions you can before using one.

Cutting the opening roughly with a thin cutting disk, I was still left with



PHOTO 104: Thanks to honing, cylinder walls almost mirror-smooth.

PHOTO 105: Roll pin in drilled hole, resting against chuck jaw ensures rod doesn't slip in chuck during threading.

PHOTO 106: Revolving centre ensures workpiece stays firmly in the chuck.

PHOTO 107: Cylinder assembly, piston and valve rods. Z-shaped ends on piston ring enable thermal expansion.

PHOTO 108: Forming oval opening in crosshead guide with small grinding stone in mill. Stainless steel glows white-hot!

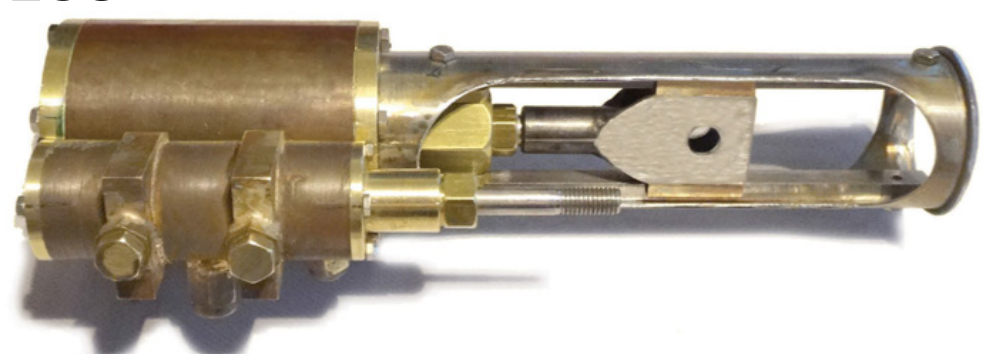
PHOTO 109: Crosshead guide consists of tube with oval openings on side, and two slide bars, made from key stock steel, bolted to the inside.

having to finish the rounded ends of the holes, left very jagged by the angle grinder operation. Since I knew it would be well-nigh impossible to mill them with my puny vertical mill, I again used a grinding operation, (**Photo 108**): A small grinding stone on an arbor was held in the mill chuck, and, running at top speed, it was slowly lowered onto the stainless tube.

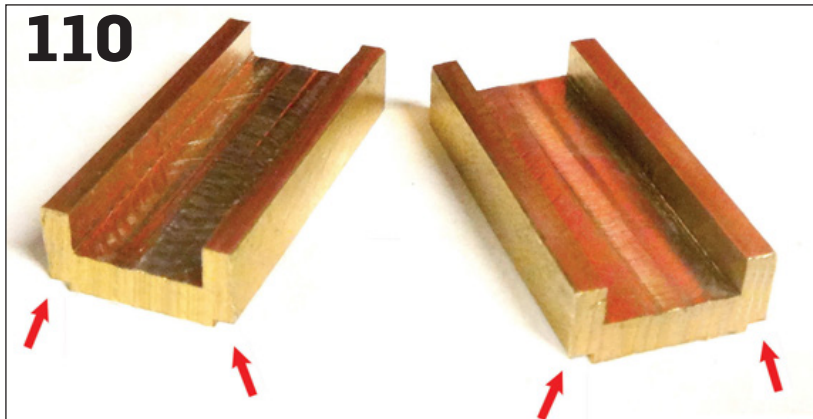
Even this method showed how difficult some stainless alloys can be; ►



109



110



111

**PHOTO 110:**

Two bronze 'shoes' for crosshead. Milled corners (at arrows) facilitate silver soldering.

PHOTO 111:

Milling crankpin hole slightly off-centre in big end of the main rod.

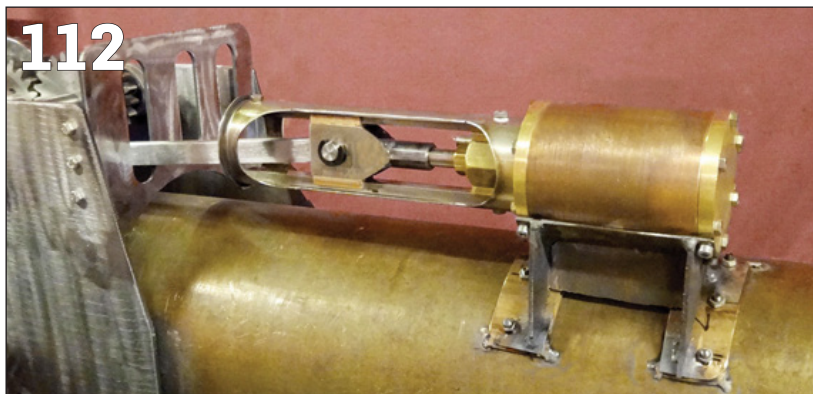
PHOTO 112:

Cylinder unit attached to boiler with a 'cradle', here temporarily tack-welded to boiler, awaiting final assembly.

PHOTO 113:

The traction engine is taking shape, even though it still lacks most of the valve gear and many other mechanisms.

112



113



the metal glowed white-hot when the stone touched it! But after several passes, with not a little trepidation at times, fearing that the stone might shatter, I had finally obtained the typical shape of a crosshead guide tube. Adding slide bars made from rectangular key stock into the tube, and a ring of stainless wire to the outer end, I could attach it to the gland housing on the cylinder cover, as seen in [Photo 109](#).

Making the crosshead

The crosshead is very simply fabricated; one piece of round steel with an internal thread that screws onto the piston rod, and two plates of plasma-cut 3mm steel welded to this piece. Two 'shoes' of bronze are silver-soldered to the plates. The shoes have milled grooves, fitting the slide bars, and on the other side, milled depressions (at arrows in [Photo 110](#)) enabling me to position them correctly when soldering them to the crosshead plates. The hole for the pivot pin of the main rod was not drilled until after the final assembly of the crosshead, ensuring that it was correctly positioned and absolutely perpendicular to the sliding surfaces.

The big end of the main rod is split, in order to be attached to the crank. However, the splitting line is not centred on the crankpin hole, instead, it is slightly offset, as seen in [Photo 111](#), where I'm using an end mill to bring the hole to exact size.

The offset enables me to insert a split bearing sleeve into the rod end, 'clicking' it in place. Thanks to the slightly narrowing space at the edge of the rod, it will not drop out. Thus, I have one less loose piece to handle when assembling the rod end over the crank pin. (If you have ever dropped a small part into the mechanism of any engine, you'll know the way I've been thinking...).

[Photo 112](#) shows the cylinder-and-crosshead assembly tentatively mounted on the boiler using a cradle made of the same copper-nickel material as the boiler. The cradle is attached with six M4 bolts on curved strips of Cu-Ni, the latter only tack-welded to the boiler at this time. The strips will be completely welded along all edges only when I'm completely satisfied that the position is final and correct.

At this stage, the project already looks like a traction engine, albeit quite stripped of details, [Photo 113](#) – the valve gear is missing, as are the feedwater pump and most of the other mechanisms that will be needed for steam operation. **EIM**

■ Coming up next time – tackling the traction engine's pipework.

Parts one to eight of this series appeared in the September 2021 to April 2022 issues of EIM and part 9 in last month's June 2022 issue. To read previous parts you can download digital back issues or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.

A Pressing Deadline...

The race was on as our resident miniature railway engineer tried to return a loco to service in time for the Fairbourne Railway's end-of-May Gala...

BY HARRY BILLMORE

I am very happy to report that after all the work I reported last month, our 6-inch scale Lynton and Barnstaple Manning Wardle 2-6-2T 'Yeo' is now running better than it ever has while I have been the engineer at the Fairbourne Railway. The coal consumption has dropped significantly, as has the water use, with the drivers reporting more power and an easier day out!

So with Yeo finally earning its keep I could turn my attention fully on to our equally 6-inch scale Darjeeling Himalayan 0-4-0, 'Sherpa'. I finished the turning operations for the axles before setting them up in the mill and using an end mill to cut the keyway into one end of each axle. Then using my laser-cut alignment tools (described properly on page 30) I machined the other keyway, making sure to get the quartering pointing the same way on each axle.

Once these were completed I then pressed the wheels onto the axles, using a square to ensure the axle went in true to start with, then continuing to check as the axle continued further down to make sure it wasn't picking up at all as it went further in.

Press cutting

I did have to modify the press slightly to allow its base stand to separate to allow the wheelsets to be put in and out in a easier manner. This involved cutting the welded-together base into two individual sections, drilling holes for the supporting pins and then using a G-clamp to hold it all back together when in use. Thankfully the press-fits all worked as intended and the wheels went on with between 12 and 15 tons of pressure.

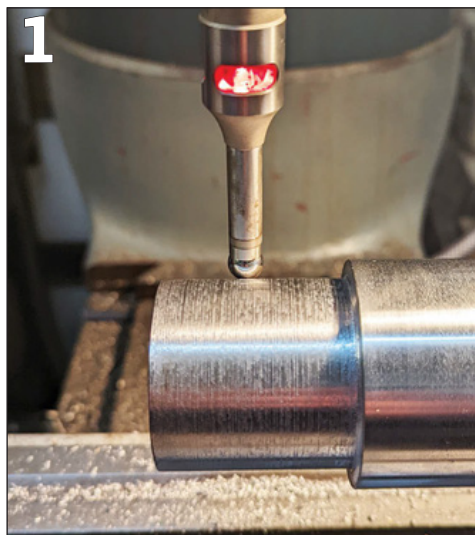


PHOTO 01: Using an edge finder to set the centre line of the axle for 'Sherpa'.

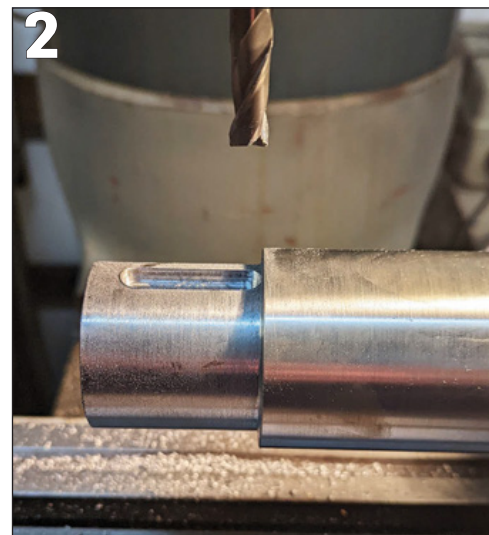


PHOTO 02: Machining the keyway into the axle end – Harry intentionally put the key towards the journal so that when he fitted the cranks, he had a place to rest it on before lining the keyways up.



PHOTO 03: Pressing the axles into the wheels with the aid of a square to ensure that the wheel goes on straight – checking repeatedly in both axes is a good idea.

PHOTO 04: The two wheelsets completed and ready to go under the engine.

PHOTO 05: Sherpa back down on its wheels for the first time since January. This made it far easier to move things around the workshop.

All photos by the author



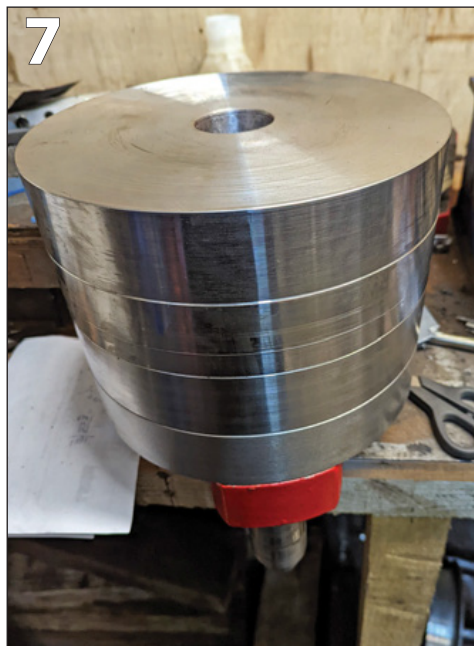


PHOTO 06: Machining the first crank blank from EN8 originally intended for carriage wheels.

PHOTO 07: A stack of crank blanks, machined to outer size, the thickness and the bore correct.

PHOTO 08: The fixture made to machine crankpin holes to same size.

PHOTO 09: One of the crank blanks on the fixture – it is a tight sliding fit on the bore and a good fit on the keyway.

PHOTO 10: The setup for drilling the crankpin holes – an R8 to MT3 adapter then an MT3 to MT4 adapter then the drill. The 12 inch extension on the mill is very useful!

PHOTO 11: 14 a finished crankpin hole, showing the holding down points.



As soon as the wheelsets were together, I put them back under the engine and put it back onto the rails, restoring a lot more flexibility to my workshop space, due to its track plan. At one end of the workshop is a sector plate and at the other is a traverser, with a single through road that passes over the only pit. This is also dual gauge (12¼-inch and 15-inch) as is one of the stub roads in the back of the workshop accessed by the traverser.

Clear road ahead

Having Sherpa up on blocks on this through road had been a headache for some time, not helped by also having two milling machines taking up space at the back of the workshop waiting for the new buyers to collect them!

With the axles completed I then started on the cranks. I machined these from discs of EN8 steel that the railway had originally bought to machine into carriage wheels – due to everything else needing work, they had sat under a bench for three years only partly machined.

I first faced the discs off, before machining the outer diameter to size, then boring the centre bore diameter to size. Before turning it around, I used a centre punch to mark the face that was perpendicular to the bore in the section of the disc that would later be cut away. This then becomes the reference face for the later operations. Once turned around it was then a simple matter of facing the cranks down to the required thickness.

Once I had four blanks machined, I used a broach to cut the keyways in the cranks, this process is detailed on page 27. Once this was complete I then made up a fixture to mount in the mill to allow me to machine all of the crankpin holes in the same orientation to the keyway.

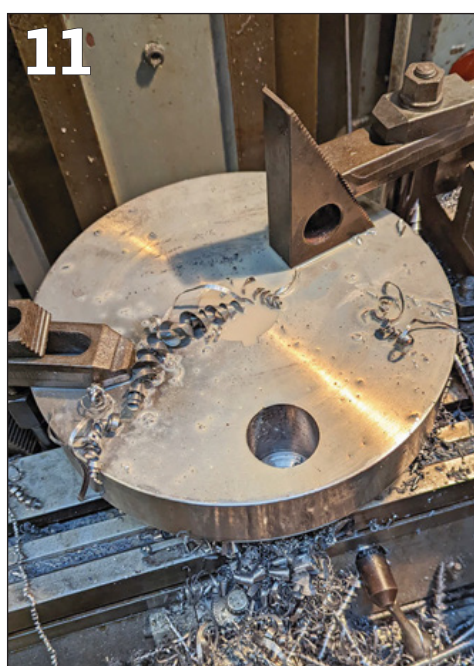


PHOTO 12: Marking centreline of crank by measuring from edge of crankpin hole and then axle bore using vernier calipers.

PHOTO 13: Crank all marked out, the centre split line and then the extra material to be removed.

PHOTO 14: Vertical bandsaw used to cut split line and remove excess material – with care this produces excellent results.

PHOTO 15: Crank sides after a couple of minutes of cleaning up with a sanding disc in the grinder.

PHOTO 16: Machined crankpins were left in the freezer for several hours at minus 18 degrees then pressed into place

PHOTO 17: Once front crankpins were pressed, they were then drilled and tapped for the end caps.

I started by turning up a top-hat shaped pin that was a tight sliding fit into the bores of the cranks, I then milled a slot in it to take the key. I machined a disc of steel large enough to support the crank and keep it flat, but not too big to prevent me clamping the crank blanks down. This was then welded to the top-hat pin I turned earlier and the whole thing mounted back in the lathe to true up the faces that will come in contact with the lathe bed and the crank reference face.

I used an end mill to machine a couple of pockets for a pair of holding-down bolts to clamp the fixture to the bed. Once all of that was together, I then used my laser-cut alignment tools again to set up the keyway in the mill to be parallel with the X axis on the mill.

Once this had been tightened down and triple-checked I could then mount the crank blank and start drilling and reaming the crankpin holes to size – this required a little creative thinking to get the R8 tool holder in the mill to MT4 on the reamer, but it all worked out.

Saw to the line

I then proceeded to mark up the centreline of the cranks, measuring from the edge of the crankpin hole and the axle bore to make sure it was in the middle. Then I measured from this line to mark out where the excess steel needed to be removed to produce the correct shape. Then followed some quality time on the vertical band-saw to split the cranks and to remove the extra material from the sides.

It was then back to the lathe to machine the crankpins, before putting them in the freezer for a few hours – this helps a remarkable amount with the pressing operation. They all were ►



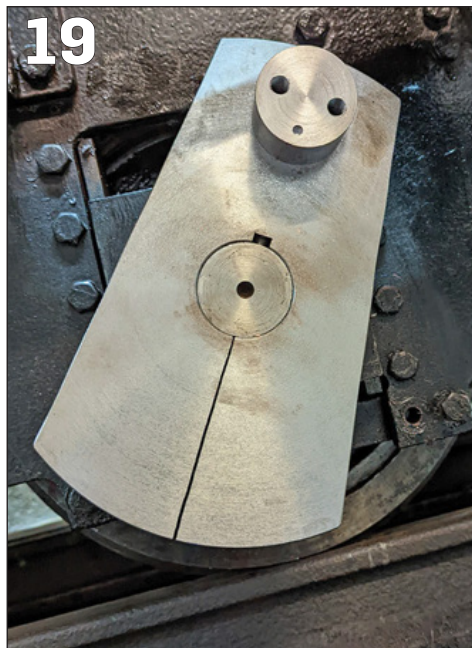


PHOTO 18: Using the long-series drill to drill the clamp bolt holes.

PHOTO 19: The first crank fitted without its clamp bolts.

PHOTO 20: Safety valve seat – evidence of scoring and a small land for the valve.

PHOTO 21: The very nice valve seat cutter borrowed from a friend.

PHOTO 22: Welding clamp holding on a bit of steel to stop the machined guide falling out of the bottom of the valve.

PHOTO 23: Seat after the cutter was done – note guide in bottom of the hole.

PHOTO 24: Sherpa on its first light-engine test over the full line length. Harry fitted the excessively large whistle just for a day, “for my personal amusement”...

pressed on with very little fuss, thankfully as by the time I pressed the last one in it had got to 8.30pm on the Tuesday before the Gala weekend.

The following day was a long one, starting with drilling and tapping the front crank pins to take the end caps, then setting up the cranks in the milling vice to cross-drill them for the clamp bolts. The first operation is to machine a flat area for the bolt head to rest on, before centre drilling, pilot drilling then using a standard-length drill to get the start of the hole to size, until I ran out of length. I swapped to a long-series drill to finish the hole all the way through.

The cranks were then flipped over and flats machined for the nuts to bear on – these are M12 x 1mm high-tensile bolts to provide an adequate clamp force on the crank.

With all the machining finished, the cranks could then be fitted to the axles and the rods could all go back on. A large sigh of relief was let out when I pushed the loco forward for a couple of rotations with the rods on and it didn't come to a grinding halt or have anything knocking into itself!

I then spent the rest of the evening putting all the rest of the rods on, as well as the brake gear that had needed to be removed to get the wheels out. I then set the return cranks to an approximate amount before heading home at about 10.30pm...

Race tech

Back in on the following morning I finished the overhaul of the safety valves using a valve seat cutter borrowed from an ex-Formula 1 racing engine builder. This did a fantastic job of removing the scores in the valve seats but did leave a slightly rough surface to be lapped in (such cutters are designed for use with



hardened internal-combustion valve seats, not bronze!).

Once this was all finished, the dome cover complete with its safety valves could go back on and the engine could be steamed. But unfortunately in my haste to get it back together I had missed one of the spring spacers in the rear safety valve, which meant that they lifted at 50psi rather than 120...

Since there is no way of adding the spacer until there is no steam in the boiler, I decided to do some light engine testing for the day to check that nothing was running hot, before sorting the spacer out on the following morning and doing loaded testing on the Friday. Thankfully nothing ran

PHOTO 25:

Carriage 19 enters service for the first time in a decade.

PHOTO 26:

A taper pin from 'Russell' – working out from the crosshead it was hit by the combination lever and dropped by the coal pile.

PHOTO 27:

Visiting engines arriving for the Fairbourne Gala.

hot and only a bit of warmth was felt from one of the coupling rod brasses so with the safety valve sorted Sherpa was back in traffic ready for the first day of the Gala!

Just to add to the fun of all of the above, I have also had to do a bit of a repair to our Welsh Highland-style loco 'Russell' – one of the taper pins that secures the crosshead to the piston rod had come adrift and been caught by the combination lever, bending it nicely before depositing it at trackside. The driver noticed the issue and reported it to me so the loco

was failed until I could have a look.

It turns out that there was quite a lot of movement between the piston rod and the crosshead, so I removed the second taper pin, reamed out both of the holes and fitted new larger pins.

The same week also saw the arrival of two of the visiting engines for the Gala which required unloading, inspecting and then shunting away. On a bright note, it did also include the entry into traffic of carriage 19 which last ran in passenger service 10 years ago – so it has not all just been hard work! **EIM**



■ EIM editor *Andrew Charman* took a brief break from signing off pages of this issue to pop over to the Fairbourne Gala on Monday 29th May. The 2-6-2T 'Christopher', built by the Exmoor Steam Railway sometime in the 1980s and visiting from the Littlehampton Miniature Railway, certainly made the most of its draincocks when departing from Penrhyn Point... Resident Welsh Highland-style 2-6-4T 'Russell' looks on.

Chris Deith, 1945 – 2022

Everyone involved with *Engineering in Miniature* magazine has been shocked to hear of the unexpected passing of our founder, Chris Deith.

Meridienne Events, the company set up by Chris to manage his successful major model engineering shows, issued the following tribute;

"It is with deep, deep sadness that we announce that Chris Deith passed away suddenly on 12th May at the age of 76 whilst enjoying a holiday in Italy with his wife, Bridget.

Chris will be remembered by many in the model engineering and hobby world as a true mastermind and entrepreneur. Born in London in 1945, he developed a passion for steam in his early teenage years and became well known in the specialist modelling world and steam preservation movement – this continued throughout his life.

In his early years he founded the well-known specialist book sales and publishing company TEE Publishing in London in 1961.

In the 1970s following a family move from London to Hinckley, Leicestershire, Chris founded the magazine, *Engineering in Miniature* which was quickly followed by the annual *Steam Heritage Guide* and *Clockmaker Magazine*.

The magazines became the catalyst for the formation of a new company Meridienne Exhibitions followed by the development of a number of specialist hobby exhibitions including the Midlands Model Engineering Exhibition which was started in 1978 and the London Model Engineering Exhibition started in 1997.

In 1990 Chris and Bridget purchased 'The Fosse' near Leamington Spa, providing a permanent home for the family and business. This was quickly followed by the creation of the Warwickshire Event Centre – the jewel in his crown.

For the past 30-plus years Chris continued to develop a full portfolio

of hobby exhibitions at the venue and also host a wide range of client events.

In addition to model engineering and associated hobbies, Chris enjoyed numerous other hobbies throughout his life including classic cars and Roman history. Chris was a real family man and involved his family in every aspect of his life including business and hobbies.

He is survived by his wife Bridget, daughter Avril, daughter-in-law Heather and three grandchildren. Sadly, his son Adrian who many will also have known, passed away in December 2021.

Chris achieved so many things during his lifetime and now with his sad passing, his daughter Avril, who has worked alongside him for many years, will continue his legacy in his honour, with the full support of family and the team."

Andrew Charman, Engineering in Miniature editor adds; I first met Chris Deith at the Midlands Model Engineering Exhibition, which I attended in my role as editor of *EIM*'s now sister magazine *Narrow Gauge World*. It was clear then he was a total enthusiast for all aspects of engineering and steam power.

Chris took time to compliment me on *NGW* and this was not the last time, more than once having received an issue he would phone me up for a chat about it and a general natter, at a time when I never imagined ever editing the magazine he had founded.

Launching the Midlands show in 1978 and *EIM* just a year later were brave moves, especially in the case of the magazine which was taking on a rival established almost 90 years earlier! But referring to my well-thumbed copy of issue no 1, I'm reminded of Chris's opening editorial in which he announced his intention to provide "a fresh approach to a model engineering magazine."

That fresh approach ranged from such basics as always ensuring the

RIGHT: The first edition of *EIM* – the magazine has developed but the values established by Chris remain.

BELOW: The Midlands show and its younger sister in London have become established and successful annual events. Photo: Phil Parker

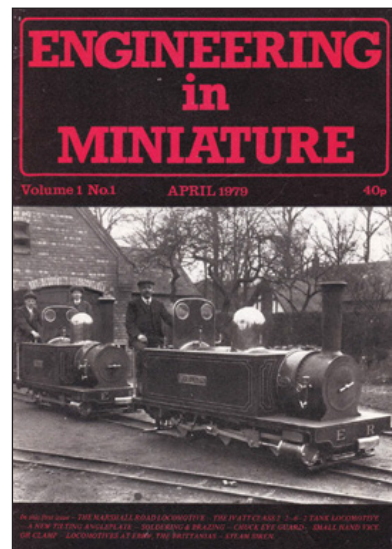
BELOW RIGHT: Chris placed great importance in encouraging the young in the hobby. Photo: John Arrowsmith



essential advertising was contained at the "outer edges" of the magazine so that they could be removed and each volume bound into a permanent reference book, to of course the content – simply put by Chris, "by model engineering enthusiasts to serve the hobby."

Those aims have held true right up to today and if I had to mention one essential it is the encouragement of new recruits to the hobby – a Young Engineers section became a regular feature of the magazine and something that the current editor considers as important an element as Chris did.

Chris will be missed by the model engineering world but in this magazine and successful shows he leaves a very strong legacy.





Friends reunited at Lakeshore 50 event

The only publicly operating 9½-inch gauge steam line in the UK celebrates its 50th anniversary this month by reuniting two locos from the same maker that have not been seen together since they were built.

Visiting the event on 2nd-3rd July at the Lakeshore Railroad, South Shields, will be 4-4-2 'Auld Reekie'. Built by Jennings of Chelmsford in 1935 to 9½-inch gauge, the loco later ran at the 10¼-inch gauge Kerr's Miniature Railway in Arbroath, Scotland before that line closed to the public in October 2020.

Due to its gauge Auld Reekie will be on static display at Lakeshore alongside operational resident Jennings locomotive 'Mountaineer'. Jennings sold Auld Reekie in 1936 to finance the construction of Mountaineer, both built as 4-4-2 Atlantics despite being inspired by the American AT&SF 3400 Class Pacific locos.

Mountaineer was not completed due to lack of funds for a boiler and was acquired partially-built in 1966 by Jack Wakefield and Don Proudlock. They finished the loco and ran it on a portable line before establishing the Lakeshore Railroad, opening in 1972.

Mountaineer was later converted to the original inspiration – a lengthened frame and extra pair of driving wheels saw the engine emerge as a 4-6-2 in 1977, and it has worked at the railway ever since.

Further visiting engines from the Downs Light Railway are expected at the anniversary Gala – more details of the event can be found at www.lakeshorerailroad.co.uk

Photo: 'Auld Reekie' will meet its sibling at the Lakeshore 50 event. Photo: Lakeshore RR

**MIDLANDS
MODEL
ENGINEERING
EXHIBITION**

THURSDAY 13th to SUNDAY 16th OCTOBER 2022

WARWICKSHIRE EVENT CENTRE

www.midlandsmodelengineering.co.uk

Midlands event set to be only major show in 2022

The sad news of the passing of Chris Deith makes it especially poignant that the show that he founded is set to make a triumphant return in 2022, after two years lost to the Covid pandemic.

Meridienne Exhibitions has confirmed that the Midlands Model Engineering Exhibition will be held between Thursday 13th and Sunday 16th October at its usual venue of the Warwickshire Event Centre, close to Leamington Spa.

Sponsored by *Engineering in Miniature* and long presented as *the* show for model engineers, the Midlands event is likely to be the only major model engineering exhibition to be held in 2022 with the London and Doncaster events again not happening.

The Midlands show enjoys tremendous support from clubs and societies and close to 30 are expected to mount displays this year, including demonstrations by leading model engineers on various aspects of the hobby.

Each year sees close to 1,000 superb models on show, from locomotives to road steam, horology and maritime models.

It is also one of the best trade-supported

shows, with up to 50 specialist model engineering stockists offering a vast range of products. And the outside area available adds a very important extra attraction in the form of the Fosse Way Steamers and their miniature traction engines.

Tickets for the exhibition are already on show and organisers are asking potential visitors to purchase their tickets in advance via the website to guarantee entry to the 2022 show. They hope to sell tickets on the day but this decision will not be made until 3rd October pending any changes to the Covid-19 restrictions.

A call is also going out for entries in the competition and display classes – some 32 classes are available covering the wide spectrum of model engineering, with cash prizes and trophies to be awarded to the best entries in each class.

Full details of the show, including how to enter the classes, a list of exhibitors and ticket-booking facilities are on the website at www.midlandsmodelengineering.co.uk. And we will be publishing our usual pull-out guide ahead of the event in the October issue.



The Midlands Model Engineering Exhibition and its very wide range of models on show have been much missed over the past couple of years. Photo: Andrew Charman

Shock at passing of Frank Cooper

In what has been a sad time for the model engineering fraternity we also have to report the death of Frank Cooper, chairman of the 7¼-inch Gauge Society and the Northern Association of Model Engineers.

Frank died at home on 3rd May – while he had suffered a long period of serious ill health his passing was unexpected and a shock for his many friends and colleagues in the hobby. His funeral was held in Doddington, Cambridgeshire on 24th May.

Frank had a very long history not only in model engineering but in the wider heritage railway scene. He was associated for many years with the 2ft 6in gauge Welshpool & Llanfair Light Railway in mid Wales, serving

in many roles including for a time acting as the line's deputy general manager while equally happy to play the 'Fat Controller' at *Thomas the Tank Engine* events!

Announcing Frank's passing on the 7¼-inch Gauge Society website, Society president Brian Reading paid tribute to the "very considerable contribution" to the hobby that Frank had given over many years.

"It is clear that he will be greatly missed not only by our Society but other associated organisations connected with miniature and heritage railways," Brian added.

The 7¼-inch Gauge Society has appointed Janet Royston as its acting chair.

Photo: John Arrowsmith



Open season...

Busy running days, track extensions and more events on offer this month...

COMPILED BY **ANDREW CHARMAN**



This month's round-up from the once again vibrant club scene is a little shorter than usual due to late news pressures on our pages – apologies for that but please be assured we still want your news, and your pictures, so keep sending in details and also your club newsletters – they all get read and assimilated!

One club that's done just that for the first time, well at least since this editor has been compiling the pages, is the **Dublin SMEE**. Ian Lake from the club has got in touch, and immediately gained our attention by enclosing some pictures (hint, hint...).

Ian tells us that on 7th May the club was at last able to resume its seasonal passenger carrying at its Marlay Park site in the city after receiving the go-ahead from the park

THIS PAGE:

Three scenes from the Dublin SMEE, which is back in action and members enjoying its new ground-level extension. The club has an impressive steaming bay (above right) which will be welcomed by two new steam locos (below). *Photos: Dublin SMEE*

authorities following further relaxing of Covid restrictions. Running for now is focussed on the club's long established raised track which caters for 3½, 5 and 7¼-inch gauges.

Meanwhile the ground-level track has been extended with a new 300-metre long loop – this has now been brought into use after a few setbacks and challenges and provides a run of more than 900 metres for 7¼-inch locos, while the shorter 650-metre loop can accommodate both 5 and 7¼-inch stock.

It's clearly a very busy time in Dublin – proving the 'build it and they will come' adage, the club has had two further 7¼-inch steam locos arrive in recent times, both capable of working with the two new vacuum braked ride-on carriages that have been funded by the council.

Very long history

Dublin believes it is one of the oldest model engineering societies around, having been founded only three years after the first in London, and in October last year it was finally able to celebrate its 120th anniversary following restrictions being eased in Ireland. A relatively low-key but welcome gathering included some visitors from miniature and steam organisations from all over the island of Ireland, with the raised, ground-level and 45mm tracks all in use. Footage from the event is on Youtube (simply search for DSMEE 120) and more information about the Dublin club can be found at <http://dsme.ie>.

Traditionally as we get towards

summer we hear of more events happening, though of course not over the past couple of years. Well we are very relieved to note that normal service appears to have been resumed – what started as a trickle of event notifications a few weeks ago has been steadily increasing in pace.

Among the latest announcements, we are particularly pleased to see that the **Wythall Miniature Railway** will be celebrating the 25th anniversary of the completion of the full circuit of its track at Transport Museum Wythall, in the southwest of Birmingham by holding a visiting loco event over the weekend of 16th-17th July.

The Wythall line featured in the October 2021 issue of **EIM**, when I visited the site and met up with a very enthusiastic group of model engineers spanning the entire age range. At the anniversary event, as well as running on the interesting circuit during the day, after the site closes to the public at 4.30pm visitors will be invited to join members for an evening barbecue. Owners of potential visiting engines are asked to get in touch with the railway at wythallminiaturerailway@gmail.com and spaces are limited so if you want to join in get in quick!

Another club about to celebrate a rather older birthday is the **Rochdale SMEE**, which is holding its 90th Anniversary Open Day on Saturday 9th July, from 10am to 4pm.

Trustee Mike Foster tells us that the club operates a raised track of 3½, 5 and 7¼-inch gauge in the woodland setting of a public park, with all the



usual facilities, including an easy loading ramp for heavy locos.

Refreshments will be available at the event and all are welcome, with or without a locomotive. But if you do come with an engine please also bring your boiler and insurance certificates, club card, and spark arrestor.

More details are available from Mike Foster (fosterm@btinternet.com) or 0742 182 4998, and the club is also on Facebook at <https://www.facebook.com/RochdaleModelEngineers>

They keep on coming! We've also heard from **The West Riding Small Locomotive Society** which will be holding its annual rally and open weekend on the 13th-14th August.

Club secretary Stuart Merton tells us all are welcome to the two full days of activity, with or without a loco. But as this is a public event with trains hauling passengers, priority running will be given to locos capable of performing that duty on the ground or raised level tracks. Again please bring boiler certificates, club insurance and spark arrestors.

Stuart also tells us that West Riding has joined the ever-growing number of clubs adding smaller-scale running to their facilities. A Garden Railway is under construction and when complete will consist of two loops around 200 feet in length using both 45mm (Gauge 1) and 32mm (O-Gauge) track with additional sidings and passing loops. This will be completed in time for the open days and available for visitors to run their locos/trains on.

Refreshments will be available throughout the days and parking is available on site – for further information check out the website, Facebook page (search for WRSLs) or by contacting Stuart Merton by email at wrsllsec@gmail.com or by phone on 01132 523258.

Keep steaming...

Talking of social media, interesting model engineering and miniature railway stories crop up on a regular basis and it's worth following our Facebook page (www.facebook.com/engineeringinminiature) as we share plenty of posts. Some lines it seems are able to call upon star power, such as the **Grimsby & Cleethorpes ME** which on 15th May had the track extension at its Waltham Windmill site officially opened by none other than *Strictly Come Dancing* star Joanne Clifton! We hear quite regularly from the Grimsby club, but we haven't seen any photos of this event (again, hint hint...).

Other lines might not be building longer tracks but they are running new locos on their lines – we mentioned in the May issue how the



THIS PAGE:

Jonathan James enjoyed a visit to the Brighthouse & Halifax ME on 8th May and found plenty of action on both ground-level (above) and raised tracks (below). Among more interesting locos on show was this 5-inch gauge model of a German DB diesel.



Hilcote Valley Railway, a 7¼-inch line running round a garden centre in Eccleshall, Staffordshire, had suffered nasty damage when a fire in a neighbouring property spread to its ticket office. Well there's been better news recently with the line gaining a new resident steam locomotive, a quarry Hunslet which has been named 'Lydia Marie' – more details of the line are at www.hilcotevalleyrailway.co.uk

With clubs busy again **EIM's** correspondents have been getting out

and about and well-known miniature railway enthusiast and writer Joanthan James sent us in some interesting pictures from a visit he made to the **Brighthouse & Halifax ME** on 8th May.

Located at Ravenssprings Park in Brighthouse, the club boasts a raised 2½, 3½ and 5-inch gauge line and a separate ground-level 7¼-inch gauge line. The raised track forms a 660 foot-long loop with one station called Ravenssprings while the ground-level





line is more than 1000 feet long with two stations called Ravensprings Low Level and Brighthouse.

Trains usually operate one Sunday per month and according to Jonathan a number of locomotives were running on both lines when he visited.

A few days later Jonathan went up in scale when he attended the **Romney, Hythe & Dymchurch Railway's** 95th anniversary Gala in Kent. This featured two visiting locomotives from fellow 15-inch gauge line the Ravenglass & Eskdale Railway, both examples of Sir Arthur Heywood's 'minimum gauge' concept though the 1894-built 0-8-2 'River Irt' has changed rather more substantially over the years than the 0-4-0T 'Katie' – mind you it can be argued that Katie has been more substantially rebuilt, being little more than a frame when the rebuild started in 1992. Part of the R&ER's museum collection (and a favourite of yours truly...) the loco top-and tailed shuttle services with the RH&DR's own Krauss 0-4-0, 'The Bug' while River Irt worked the whole of the 13½-mile line.

There does seem to be plenty of new model engineering around at present, which of course is very good news. Sussex standard-gauge heritage giant the Bluebell Railway, for example, has recently been granted planning permission for a miniature line adjacent to the picnic area at its Sheffield Park base, which is apparently being built to keep the volunteers enthused as much as entertaining the visitors...

Good to see newsletters continuing to arrive from clubs outside the UK, though the latest news from the **Sydney Live Steamers** is on a sad note with the passing of one of the club's most stalwart members, Trevor Arney.

"Trevor joined the Society in 1970 and was very involved in the creation of some of the Society's most valued assets," says Warwick from the SLSMS. "He was the principal builder of the club house – this project took many years and Trevor was at the heart of it," adding that he also built a major retaining wall and installed the club's electrical system.

Brighter stuff in the latest SLSMS



ABOVE LEFT: Mighty minimum gauge – Heywood 'Katie' at the Romney 95th Gala. *Photo: Jonathan James*

ABOVE: Trevor Arney will be sadly missed by the Sydney club.

LEFT: One more shot from our Ed's brief visit to the Fairbourne Railway Gala on 29th May and Steve Thorpe is clearly unfazed by some Welsh 'liquid sunshine' as he drives tech ed Harry Billmore's 'Scamp' towards an interesting selection of rolling stock. In the background 'Russell' awaits its next train. *Photo: Andrew Charman*



newsletter which features yet more completed new build projects, an Australian Clyde Engineering 4-6-0 'Cambewarra' built by member Ray Lee and a Fowler ploughing engine in 3-inch scale built by Ross Bishop.

Clearly model engineering is alive and well 'down under' despite the ongoing Covid issues which have continued to affect Australia for longer than us in the UK. There's some great models coming out of Australia, our cover model in this issue a case in point.

Smart skills

We have featured the **Downs Light Railway** a few times in the past, a 9½-inch line at a school in Worcestershire with a long history and still run by the schoolchildren, and we keep on hearing good news from this most excellent organisation.

The latest from the Downs is the revival of a shunting competition that was originally run for the children in the 1990s by James Boyd, a well-known railway historian who was a former Downs pupil and a trustee of the line.

The revival involved two teams of four children each who had the task of arranging a train in the station in a set order, with their ranking based on the number of moves made and the time taken. The youngsters had to do everything properly, driving the locos, with penalty points for such things as pushing rolling stock.

This sounds an excellent idea – it interests young members while also teaching them correct railway operations. Perhaps other clubs might consider encouraging their younger recruits in such a way?

And just like that, we are out of space again. Keep the newsletters, reports and photos (please, photos!) coming in – why not enjoy your summer with some visits to clubs and railways, and then share your pictures with your fellow readers in these pages? The address is on page 3... **EIM**

DIARY

As previously reported the diary has returned after a two-year absence but readers should be aware that we are only publishing dates that have been confirmed, and with the continuing uncertainty over the decline of the Covid pandemic we strongly recommend that readers check with the club or track concerned just before travelling to any events or meetings.

EVERY SATURDAY

(Weather permitting)

Sussex MLS public running, Beech Hurst Gardens, Haywards Heath RH16 4BB, 2-5pm

EVERY SUNDAY

(Weather permitting)

North Wilts ME public running, Coate Water Country Pk, East Swindon, SN3 6FG, 11am-5pm

Ryedale ME public running, Gilling East, North Yorks YO02 4JJ

Southampton SME public running, Nursery Rd, Southampton SO18 1PQ 10.30am-4pm

JULY

1 Hereford SME Summer steam-up/
3 60th anniv, Broomy Hill, Hereford HR4 0LJ, hsme.co.uk/ noon-4.30pm

2 Tiverton & Dist MES running, Rackenford, EX16 8EF

2 Guildford ME Stoke Park Railway
3 Gala, Stoke Pk, Guildford GU1 1TU, 10am-5pm

2 Lakeshore Railroad 50th Gala, South
3 Shields, details at www.lakeshorerailroad.co.uk (see page 41)

3 Bradford ME Rae Gala Day, Northcliff, BD18 3DD 2-4.30pm

3 Rugby ME members running, Onley Lane, Rugby CV22 5QD,

6 Bradford ME Meeting, Steerage Trophy Competition, Wibsey Boating Park, BD6 3QD 7.30pm

6 Bristol SME Ashton Court Evening, Begbrook Social Club, Stapleton, Bristol BS16 1HY, from 4pm

8 Tiverton & Dist MES running, Rackenford, EX16 8EF

9 Rochdale SMEE 90th Anniversary Open Day, Springfield Pk, Bolton Rd, Rochdale OL11 4RE 10am-4pm

9 Rugby ME Narrow Gauge Wkend,
10 Onley Lane, Rugby CV22 5QD

10 Cardiff ME open day, Heath Pk, Cardiff CF14 4AW

10 Havering Miniature Railway Club public running, 11am-4pm, Lodge Farm Park, Romford. RM2 5AD

10 Lincoln & District ME running at car boot sale, North Scarle playing field, LN6 9ER

10 Southampton SME visit from Eastleigh Model Boat Club, Nursery Rd, Southampton SO18 1PQ

10 Worthing ME public running, Field Place, The Boulevard, Worthing BN13 1NP 2-5pm

14 Worthing ME Club Meeting, Field Place, The Boulevard, Worthing BN13 1NP 7.30pm

16 Wythall Miniature Railway 25th
17 Anniversary Visiting Loco Weekend, Transport Museum Wythall, Birmingham B47 6JA

17 Rugby ME public running, Onley Ln, Rugby CV22 5QD, 11am-1pm, 2-4pm

17 Tiverton & Dist MES running, Rackenford, EX16 8EF

22 Guildford ME IMLEC loco efficiency
24 competition, Stoke Pk, Guildford GU1 1TU, 10am-5pm

23 Worthing ME public running, Field
24 Place, The Boulevard, Worthing BN13 1NP Sat 10am-3pm, Sun 2-5pm

24 Bradford ME Open Day & public running, Northcliff, BD18 3DD Members 11.30am, public 1.30-4pm

24 Havering Miniature Railway Club public running, 11am-4pm, Lodge Farm Park, Romford. RM2 5AD

24 Lincoln & District ME running at car boot sale, North Scarle playing field, LN6 9ER

28 Worthing ME Club Meeting, Bessemer Steel by Tim Smith, Field Place, Worthing BN13 1NP 7.30pm

30 Cardiff ME Steam-up & family day, Heath Pk, Cardiff CF14 4AW

30 Romney Marsh ME running for New Romney Country Fayre, Rolfe Lane, New Romney, Kent

31 Hereford SME public running, Broomy Hill, Hereford HR4 0LJ, <https://hsme.co.uk/> noon-4.30pm

31 High Wycombe ME public running, Watchet Lane, Holmer Green, High Wycombe, HP15 6UF, 11am-5pm

AUGUST

3 Bradford ME evening running, crepes & social, Northcliff, BD18 3DD Members 11.30am, public 1.30-4pm

4 Cardiff ME Members Projects, Heath Pk, Cardiff CF14 4AW

4 Guildford ME public running, Stoke Pk, Guildford GU1 1TU, 10am-1pm

6 Tiverton & Dist MES running, Rackenford, EX16 8EF

7 Cardiff ME open day, Heath Pk, Cardiff CF14 4AW

7 Guildford ME Small Engine Group Open Meeting, Stoke Pk, Guildford GU1 1TU, 2-5pm

7 Havering Miniature Railway Club public running, 11am-4pm, Lodge Farm Park, Romford. RM2 5AD

7 Lincoln & District ME running at car boot sale, North Scarle playing field, LN6 9ER

7 Rugby ME members running, Onley Ln, Rugby CV22 5QD

Southampton SME Sailability Charity Day, Nursery Rd, Southampton SO18 1PQ

11 Worthing ME Club Meeting, Field Place, Worthing BN13 1NP 7.30pm

12 Tiverton & Dist ME a'noon/eve running, Rackenford, EX16 8EF

13 Old Locomotive Committee
Lionsmeet 2022, Worcester ME, Waverley Str, Worcester, WR5 3DH

13 Rugby ME Standard Gauge Weekend,
14 Onley Ln, Rugby CV22 5QD

13 West Riding SLS Gala Weekend,
14 behind Freedom House Annex, Bradford Rd, Tingley, Wakefield

14 Guildford ME public running, Stoke Pk, Guildford GU1 1TU, 2-5pm

14 Hereford SME public running, Broomy Hill, Hereford HR4 0LJ, <https://hsme.co.uk/> noon-4.30pm

14 Worthing ME public running, Field Place, The Boulevard, Worthing BN13 1NP, 2-5pm

20 Cardiff ME Steam-up & family day, Heath Pk, Cardiff CF14 4AW

21 Bradford ME Open Day & public running, Northcliff, BD18 3DD Members 11.30am, public 1.30-4pm

21 Havering Miniature Railway Club public running, 11am-4pm, Lodge Farm Park, Romford. RM2 5AD

21 Lincoln & District ME running at car boot sale, North Scarle playing field, LN6 9ER

21 Rugby ME public running, Onley Ln, Rugby CV22 5QD, 11am-1pm, 2-4pm

21 Tiverton & Dist MES running, Rackenford, EX16 8EF

25 Guildford ME public running, Stoke Pk, Guildford GU1 1TU, 10am-1pm

25 Worthing ME Club Meeting, 30 years a model engineer by Chris Devenish, Field Place, Worthing BN13 1NP 7.30pm

27 Ryedale ME Main Line Rally, Gilling East, North Yorks YO02 4JJ

28 Worthing ME public running, Field Place, The Boulevard BN13 1NP, 2-5pm

28 Cardiff ME open day, Heath Pk,
29 Cardiff CF14 4AW

28 Hereford SME public running, Broomy Hill, Hereford HR4 0LJ, <https://hsme.co.uk/> noon-4.30pm

29 North Wilts ME public running, Coate Water Country Pk, East Swindon, SN3 6FG, 11am-5pm

31 Rugby ME midweek public running, Onley Ln, Rugby CV22 5QD

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



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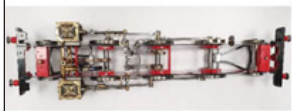
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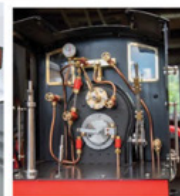
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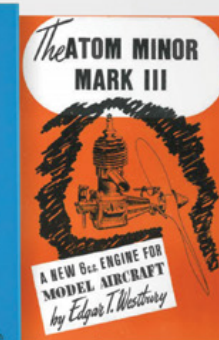
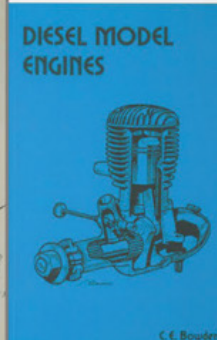
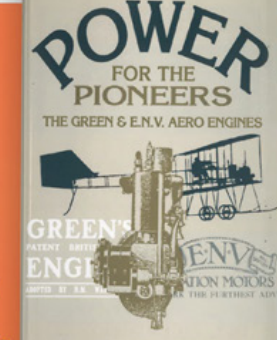
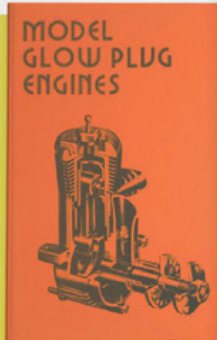
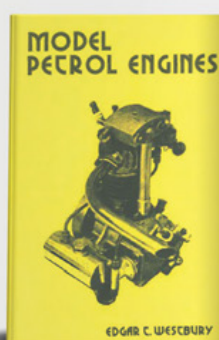
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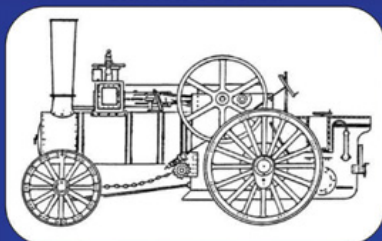
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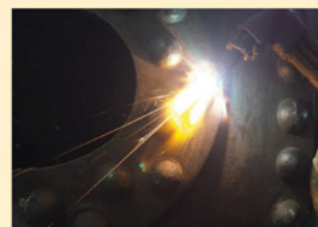
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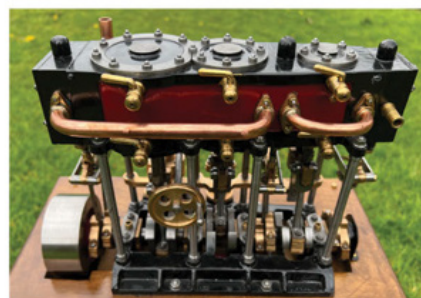
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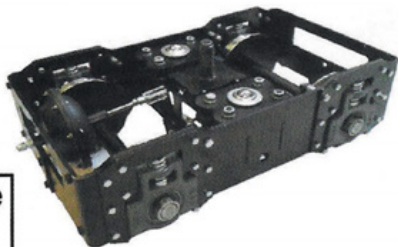
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A finely built 3 1/2 inch gauge Stanier 2-6-4T to Martin Evans' elegant "Jubilee" design. Standard of workmanship is good throughout, machining is crisp, motionwork and valve gear well-executed, the platework neatly formed. Paintwork is to a good standard, it presents very well.

ref 9743 £3,450



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A 2 inch scale Clayton & Shuttleworth agricultural engine, rare in this scale. A well-made older engine. It runs well on air, with some wear apparent in the motionwork and valve gear. Boiler is copper and appears silver soldered with nutted and calked firebox stays.

ref 10340 £4,950



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2 INCH SCALE CLAYTON STEAM WAGON

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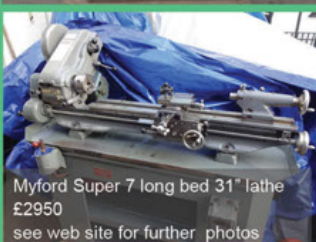
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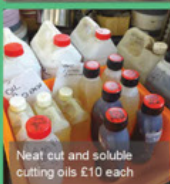
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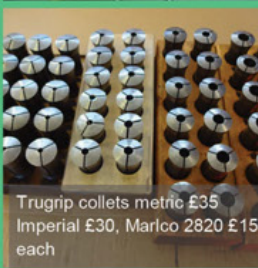
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