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THE LEADING MAGAZINE FOR HOBBY ENGINEERS AND MODEL MAKERS

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Volume: 234, Issue: 4763, April 2025

Milling in the Lathe

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Making Small Threads

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A 4" Garrett

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BARHAM'S TRACTION
ENGINE ARCHIE



INSIDE this packed issue:

We focus on challenging drilling operations: Avoiding breakages when using small drills - How to drill accurate oblique holes - Making and using a guide bush for larger drills • Casting Polyurethane Tyres
A GWR Pannier Tank in 3 1/2" Gauge • Workholding in your lathe and mill • A Corliss Valve Steam Engine • Meet the Editor • The BR Standard 2-6-0 Mogul • The Stationary Steam Engine
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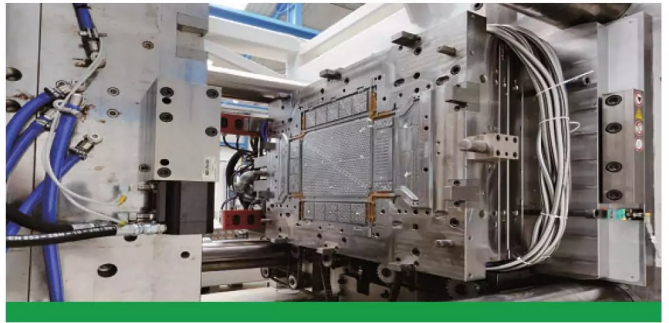
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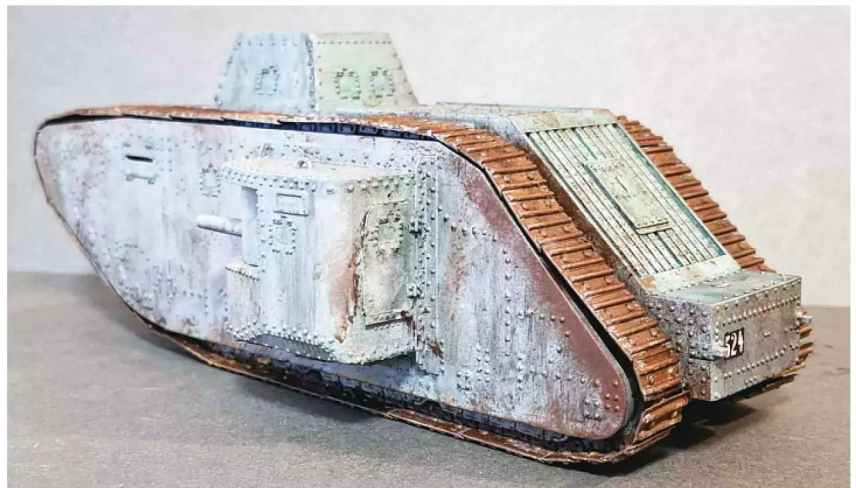
SMOKE RINGS

I'd like to offer my thanks to readers for what has, on the whole, been a positive reception for the first issue of Model Engineer & Workshop. Naturally there were a few things we didn't get quite right and there are changes in this issue and no doubt fine-tuning to take place. I would particularly appreciate your feedback on the sort of content you want to

see, especially compared to *MEW* and *ME*. You can give this by visiting our reader survey (and potentially win a year's subscription too). Just visit: www.surveymonkey.com/r/VKQJJ93 where you will find the survey and full terms and conditions.



On the Editor's Bench



In the last issue I mentioned PCBWay and their metal 3D printing service. I now have a remarkable little crosshead for one of my stationary engine models on my bench. I will be doing some finish machining and fitting it to my model in time for the next issue, watch this space.

I've also been down something of a rabbit hole, researching the WW1 German A7v tank. Only twenty were made, and a surprising number of photographs as well as military records exist. Each has its own distinguishing features, but, as always, information from the internet is not to always accurate. I have found a copy of the second edition of *Sturmpanzer A7v: First of the Panzers* by Strasheim, Rainer and Hundleby. I've spent much time cross-referencing photos to my own excel spreadsheet and the datasheets on individual tanks in the

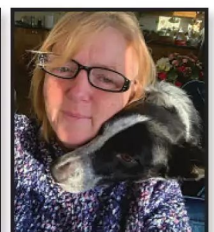
book. My initial aim is to design and make a series of resin-printed models of notable examples, the photo shows my model of the A7Vu variant. I'm increasingly thinking that a 1:16 scale model in metal could be an excellent workshop project.

Neil Wyatt

Neil Wyatt



Neil Wyatt
Editor



Diane Carney
Deputy Editor



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It was once rare to find milling machines in amateur workshops, Rod Jenkins has found the skills and equipment for milling in the lathe still have their place.

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Gerald Martyn continues his construction guide with the valve gear.

27 Creating Polyurethane Traction Engine Tyres and Strakes

Paul Zeusche concludes his insights into casting in flexible polymer by describing the process for single-piece tyres.

26 A Miniature Oil Can

This tiny working oilcan by Peter Evans can be built for practical jokes or used as a scale oiler for models.

37 Working on the Lathe: Drilling and Boring

Neil Raine looks in detail at the use of small twist drills concentrating on how to minimise breakages.

39 Quick Notes from the Workshop

Why do centre punches come in sets of three? We look at the different types.

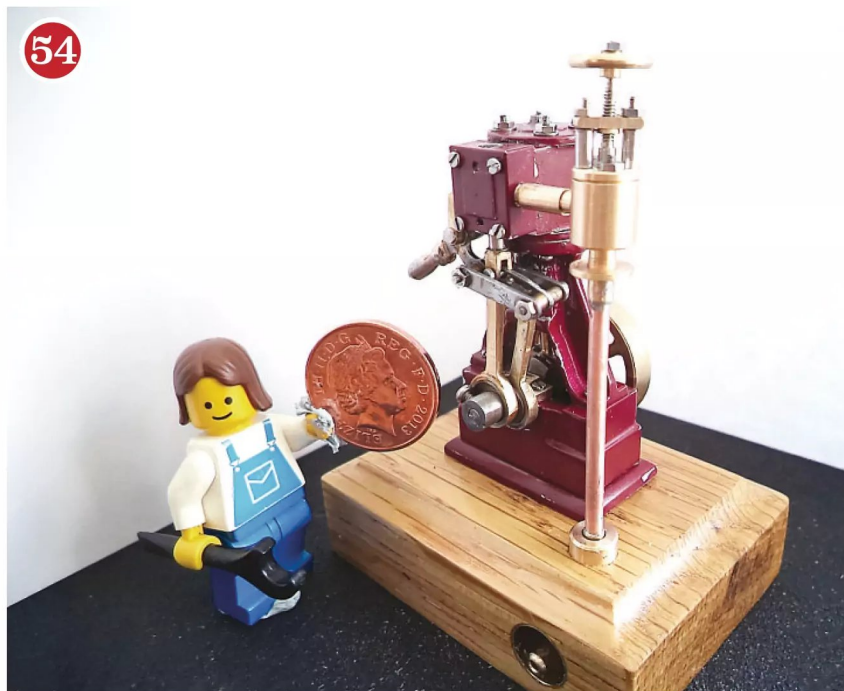
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44 How (Not) to Build a Locomotive for Someone Else.

Jim Woods and Jonathan Bregazzi conclude their story with the completion

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of 2-4-0 Beyer Peacock tank locomotive, Loch.

47 Extracting a Broken Stud

To conclude our drilling challenges, Alan Donovan makes a guide bush to assist with extracting a stud from a cylinder casting.

52 The Stationary Steam Engine

Ron Fitzgerald continues his notes on the earliest steam locomotives.

54 Making Small Threads

Not drilling, but still on the topic of avoiding breaking delicate tooling, Stewart Hart shares designs for some smaller tapping and threading tools.

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Alan Barnes visited Chris Barham to discuss the construction of a fine model traction engine.

77 The BR Standard 2-6-0 Class 4 Standard Engine

Doug Hewson details the valve gear for his 5" gauge Mogul design.



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Regulars

3 Smoke Rings

An update on progress with *Model Engineer & Workshop* and news of what's on the Editor's bench.

41 Postbag

Another well-stuffed postbag this month, with more comments, questions and ideas. Send the editors your letters at meweditor@mortons.co.uk.

26 Readers' Tips

This month our winner has an excellent approach to machining gib strips. Send your tips to meweditor@mortons.co.uk, you could win a prize.

50 On the Wire

News from the moon, a very large lathe and an announcement about ownership of ME&W.

68 Club Diary

Are you looking for an interesting evening or day out? Here's a month-by-month guide to club events around the UK.

76 Club News

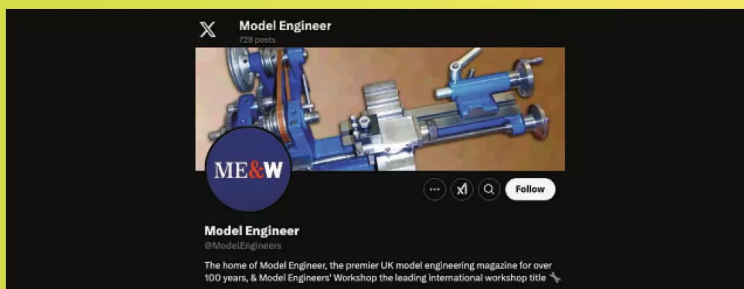
Geoff Theasby shares his regular round up of what's been happening at clubs across the country.

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Extra Content!

Your magazine is growing and changing into Model Engineer & Workshop. Find out more and let us know what you would like to see in the new, larger magazine at:

www.model-engineer.co.uk/forums

Visit the forum to download files for David Thomas' belt joining jig.
<https://www.model-engineer.co.uk/787489/belt-joining-jig/>



Hot topics on the forum include:

- Warco WM18B CNC conversion started by Tomek.
A neatly executed conversion and some photographs of the results.
- Clarkson Tool and Cutter Grinder Operator's Manual started by Derek Toller 1.
If you need a manual for an old machine tool the Forum is a great place to ask for help!
- A "Weaver" 1CC Diesel Engine started by Keith Beaumont.
A fantastic little engine and some great machining and anodising work.
- Taig lathe DC motor started by Peter Cook 6.
A well-executed power plant swap, for those with competence in electrical work.

Come and have a Chat!

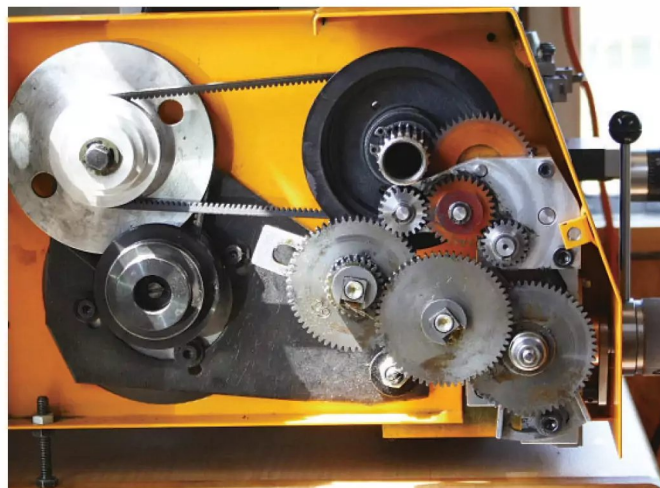
As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. Come and join us – it's free to all readers!

On the Cover



Our cover features the use of a rotary tool with a cutoff wheel, a less conventional approach to milling on the lathe. Read more from Rod Jenkins starting on page 9.

Next Issue



In our next issue, Graham Meek presents his design for a screwcutting clutch to fit the Emco Compact 5 lathe.

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COVENTRY, CV1 1HT	02476 724227	LEEDS, LS4 2AS	0113 231 0400	PETERBOROUGH, PE1 2PE	01733 311770	WOLVERHAMPTON, WV4 6EL	01902 494186
CRYDON, CR2 6EU	0208 763 0640	LEICESTER, LE4 6PN	0116 261 0688	PLYMOUTH, PL4 9HY	01752 254050	WORCESTER, WR1 1JZ	01905 723451
DARLINGTON, DL1 1RB	01325 380841	LINCOLN, LN5 8HG	01522 543036	POOLE, BH14 9HT	01202 717913		

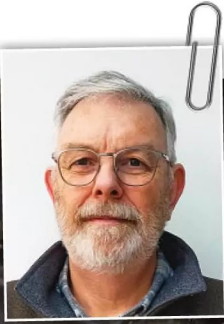


Photo 3: Arrand milling spindle.

Milling in the Lathe

Up until the Millennium, milling machines were not a common sight in our workshops, there are still many readers that have only a lathe. **Rod Jenkins** shares some of his experiences.

“Good grief Rod, why on earth would you want to mill in the lathe, you’ve got a perfectly good milling machine?” Well, it was not always so, but it is a good question. I think it is generally agreed that if you only have one machine tool then the most versatile is the lathe. The addition of a vertical slide allows the user to hold a cutter in the lathe spindle to achieve some simple milling tasks, often enough to make a small stationary engine or, indeed, those milling tasks required to make even a 5-inch gauge locomotive, such as cutting steam ports for slide valves. These days a small milling machine is available for only three or four times the cost of a good vertical slide and will be infinitely more capable. I have, however, been on a journey with lathe milling so perhaps you can come with me while I explain my obsession and you can decide if this is a good answer... Milling or drilling in the lathe by holding

a cutter in the chuck and packing up the job on the cross slide is a pretty poor substitute for a proper milling machine of any size, but it will do the job for small items. Adding a vertical slide greatly enhances and eases this approach. In some cases, though, the vertical slide will help one achieve something that can’t be done any other way, at least in my workshop. One problem that occurred was drilling holes in the end of a 1.5 x 1 inch mild steel bar for the George Thomas bending rolls. At thirteen inches they were far too long to fit under the spindle of the mill and it would have been difficult though (I must add) not impossible to contrive a fitment over the edge of the drill table. The simple solution was to fit a vertical slide to the lathe cross slide and drill the holes as shown in **photo 1**. This slide was picked up at a local steam fair for £25 – my thoughts being that I would use it to modify my Worden tool grinder to have an adjustable height grindstone, an idea now abandoned. This particular

vertical slide is quite interesting in that it is very similar to the design for the Potts milling spindle version but is rather bigger and has T bolts that are sized for fitting the slots in the Myford cross slide. The integral vice is a useful time saver. A vertical slide can also be useful for holding other tools such as the Dremel shown in **photo 2**. Amongst the box of bits that came with my second hand Myford Super 7 lathe were the castings for the George Thomas Headstock Dividing Attachment (HDA). This is a refinement on the design of J A Radford that uses a worm on the bull wheel to turn the lathe into a dividing head. Having made the HAD, I had a sophisticated indexing system for the lathe so I thought it would be nice to cut my own gears for small i.c. engines. So, if the lathe spindle is doing the dividing work, I would need something to turn the milling cutters. Which brings me to the real point of this discourse: The Milling Spindle. Reading the model engineering books

Photo 1: Drilling the end of a long beam.



from a generation or two ago there are references, with some reverence, to the Potts milling spindle. The Potts was available in several versions, one of which could be bolted to a vertical slide and my lathe came with a Myford

swivelling vertical slide. But the Potts was sadly long out of production. However, at that time in the 1980s, Arrand Engineering were advertising their wares in the Model Engineer magazine and amongst which was their

milling spindle. I purchased one of these, **photo 3**, and I was pretty much set up for gear cutting. I just needed a method of driving the spindle. The concept of having a separate spindle for milling and drilling on the lathe



Photo 2: Holding a Dremel.

is very old and probably had its genesis on the early 19th century ornamental turning lathes, such as those made by Holtzapffel or Birch. Some quite complex overhead drive systems for these spindles have been described – an example is shown in **photo 4**. The need for this complication was due to the requirement to keep a leather or cotton drive belt tensioned while allowing movement of the milling spindle. Fortunately modern polymer drive belts with some stretch in them and compact electric motors allow us to use a simpler design. My overhead gear is shown in **photo 5**. It consists of a 1/6hp induction motor together with a box that contains a starting capacitor, on/off and reversing switches. The whole thing hangs from some ½" steel bars connected with old laboratory clamps. For gear making with home-made carbon steel cutters I can put a countershaft pulley in the system to bring down the cutting speed.

One of the problems with my Sharp milling machine is that it does have restricted headroom. Mounting a chuck on a rotary table in order to drill a pattern of holes in the face of a disk isn't a straightforward option and the combination takes up most of the available space. Using a milling spindle in the lathe overcomes this issue and without having to move the job to the mill. Over the years I have found that well over 90% of drilling and milling using the spindle on the lathe is done at centre height. So I made a fixture for the milling spindle that fits into the top-slide hole in the cross-slide and, when bolted to the fixture, the milling spindle is at lathe centre height. Depending on how the spindle is orientated this is perfect for milling keyways and drilling cross holes. However, my first design didn't allow the cutter to get close enough to the centre line of the lathe when parallel to that axis. The modified design with several mounting options is shown in **photo 6**.

While keeping an eye on the internet, I noticed a Myford fixed (non-swivelling) vertical slide together with a home-made milling spindle, that I recognised as an Arrand, being offered by one of the well-known model engineering suppliers and which I won for a cheeky bid. My thought was that the slide and spindle could all be motorised in one package, that could be quickly installed on the lathe cross slide instead of the top slide and would avoid having to set up the overhead drive gear. The spindle is driven by a 120 Watt sewing machine motor and the two are mounted together on the vertical slide with a bit

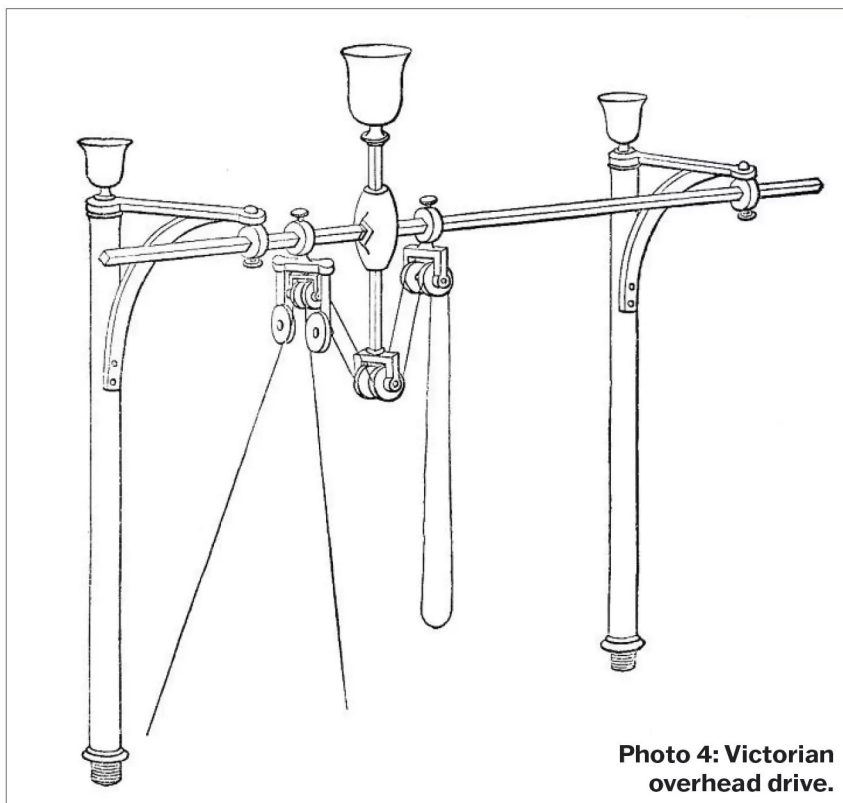


Photo 4: Victorian overhead drive.

of bent 3/32 inch steel plate, **photo 7**. My slide does not have a zero-able index on the lead screw which actually turns out to be an advantage since I know the reading for the centre line of the spindle to be on the lathe centre line and I have marked this with a red line. The Myford slide is designed to be fitted to the Myford Super 7 cross slide either with 2 bolts straddling a pair of T slots or with both bolts in the same slot so that the face of the slide is either perpendicular or parallel to the lathe axis. I have an ER11 1MT collet chuck mounted in the Arrand spindle and a set of 1 to 7mm collets in 0.5mm steps. With this configuration, not only can I drill or mill items held in the lathe chuck I can, by rotating the slide 90°, drill a cross hole or mill a key way down the length of a shaft. The sewing machine motor will cope with milling cutters up to ¼"/6mm or will drill up to similar diameters although it does prefer to have a pilot hole for drilling holes larger than 3/16 inch or 4.5mm in steel.

Some years ago, a milling spindle with an integrated motor, the Payne Quick-Step, became available. This device could be mounted on a tool-post, even a quick-change tool-post, but the cost was the price of a new milling machine! Always on the lookout for an easier set up and an excuse to make more tooling I was attracted to



Photo 5: Overhead gear.

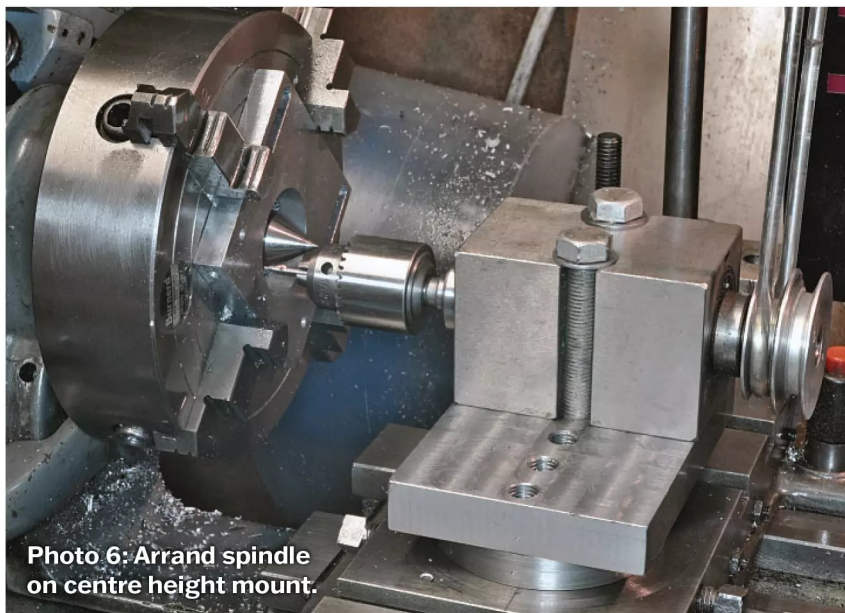


Photo 6: Arrand spindle on centre height mount.



Photo 7: Milling a long keyway.

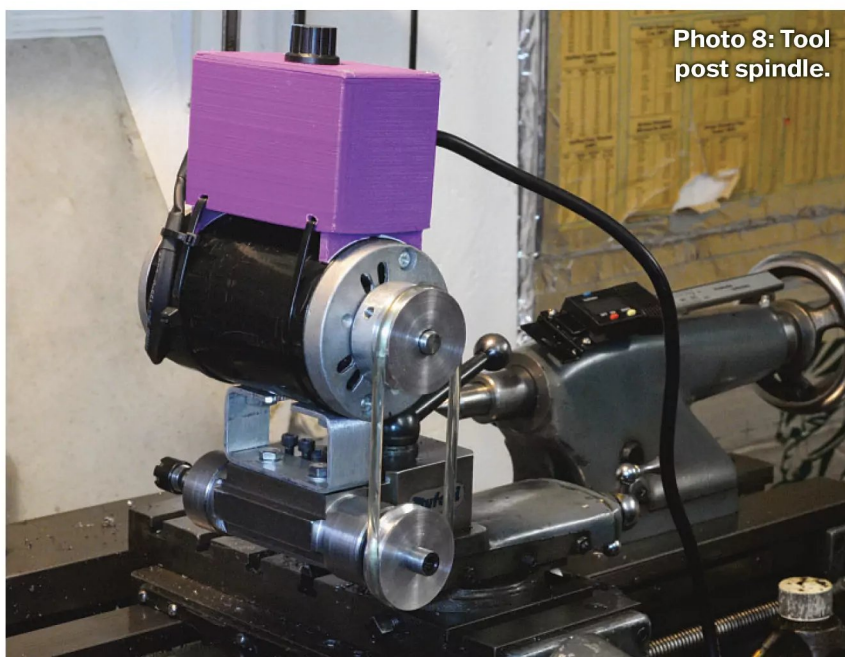


Photo 8: Tool post spindle.

the concept and contrived something similar for myself. The Quick-Step had a built-in movement in the vertical axis but, as stated, I rarely need this capability. On my version I have used an ER11 collet chuck with a 12mm plain shank mounted between a pair of angular contact bearings in a steel body. These plain shank collet chucks are pretty tough, and I had to anneal the end before I could cut a fine thread for the end float adjustment nut. The spindle body has a flat milled on either side so that it can be attached to a Myford-Dickson quick change tool-holder which allows precise height adjustment to the lathe axis. The motor is a 200W DC unit bought together with an accompanying AC/DC converter and speed control, **photo 8**. The Myford Super 7 lathe lends itself to direct indexing on the lathe spindle because the bull wheel, which is used when utilising back gear but is normally locked to the spindle, has 60 teeth; this gives many options for direct dividing by using a spring loaded detent to locate in the gap between the gear teeth. Using this method 2,3,4,5,6,10 and more divisions are available. One notable and sometimes needed exception is eight divisions since $60 \div 8$ is 7.5 teeth for each division. This can be overcome by having a detent with a notch in it, that can be rotated to straddle a gear tooth as well as the tooth gap. My version of the bull wheel detent is shown in **photo 9** and is closely based on a design by Harold Hall. I have modified Harold's design to give a quick release and set capability by having a permanent mount on the lathe into which the detent device can be quickly located. Together, the tool post mounted milling spindle and bull wheel indexer let me rapidly set up for most of my milling in the lathe requirements. At this point the reader will have noticed that I have more vertical slides than any sane person should possess but, actually, there is one more. **Photo 10** shows a Lorch vertical slide that I refurbished and fitted with a milling spindle for use on my Pultra lathe. This spindle is made from an 8mm straight shank ER11 chuck. **Photo 11** shows the spindle with the heat affected region resulting from the anneal I had to do to cut the threads. In this case the bearings are Oilite, pressed into the housing. When I had a go at making Edgar T. Westbury's Wyvern open crank engine, I wanted to make the gears myself. These helical gears drive the side shaft which controls the cams and therefore include a 2:1 ratio. ETW's design calls for gears of the same diameter, a not immediately obvious

solution that relies on the phenomenon that a pair of helical gears at right angles will mesh if their helix angles add up to 90° . The diameter of helical gears of the same Diametrical Pitch (or MOD) is dependent on the helix angle so by choosing the correct angles the same diameter effect can be achieved. The "magic angles" to give a right-angle drive, for 8 and 16 tooth gears respectively are 63.4° and 26.6° , in this case. To make these I had to go back to my basic milling set up in the lathe for using Brown & Sharpe type gear cutters. The milling spindle was set up at the helix angle on the swivelling vertical slide, the lathe change-wheels (and gear box) were set to give the correct lead, and the overhead gear drove the spindle. The lathe carriage was driven by the lead-screw hand-wheel to rotate the gear blank under the cutter as it travelled towards the head-stock for each tooth, **photo 12**. The finished gears are shown in **photo 13**.

That is my milling spindle journey to date. If you've travelled this far with me; I hope I have given some ideas for ways to use a milling spindle in the lathe. Second hand spindles like the Potts or Arrand do turn up for sale on the web from time to time, and I see that the Sherline catalogue includes a No1 Morse taper headstock which would seem to make a very nice milling spindle. There are, of course, many small routing type motorised spindles available for the CNC community in all sorts of sizes. I have no experience of these, but my fear is that their design speed is rather too fast for the sort of work I have described and that they will have insufficient torque when slowed down to perhaps 200rpm if used for gear cutting. 🍷

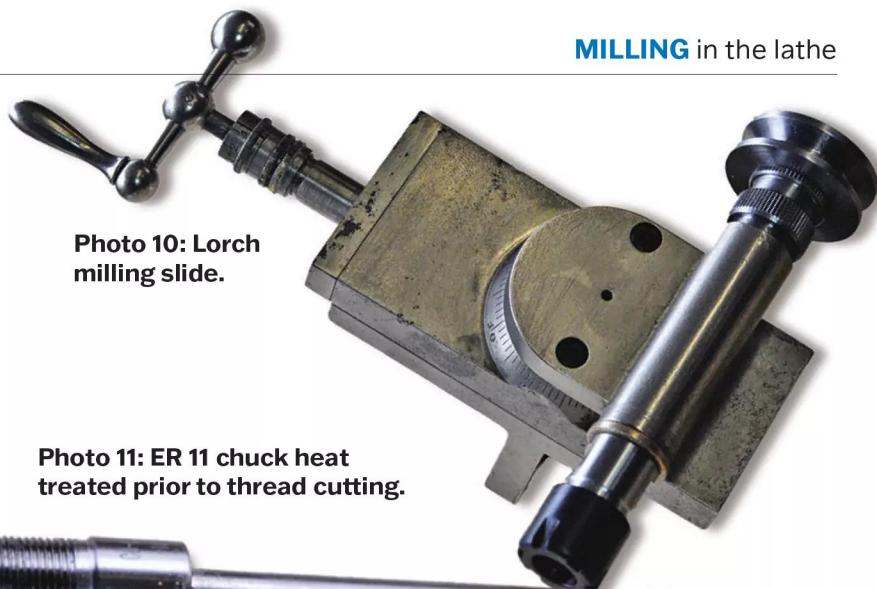


Photo 10: Lorch milling slide.



Photo 11: ER 11 chuck heat treated prior to thread cutting.

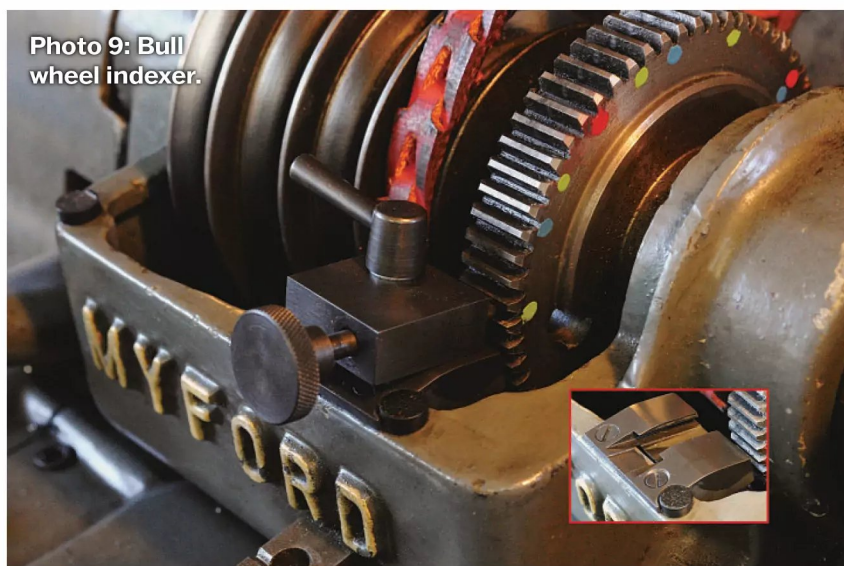


Photo 9: Bull wheel indexer.

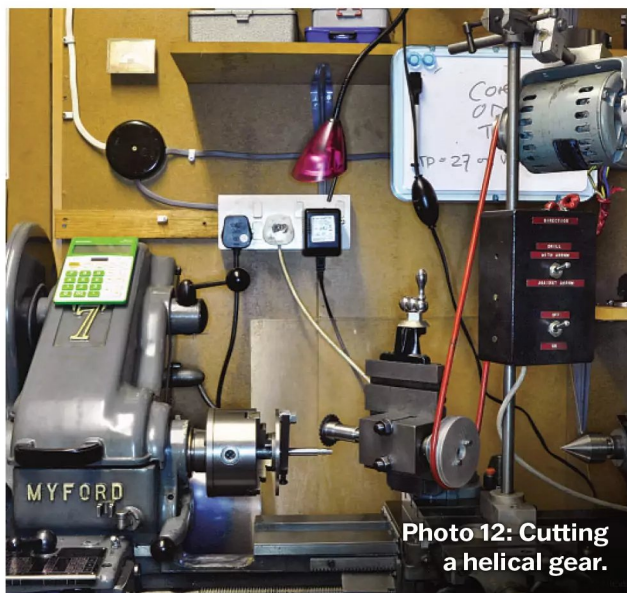


Photo 12: Cutting a helical gear.



Photo 13: Helical gears.

Readers of Model Engineer may be less familiar with former Model Engineers' Workshop editor, Neil Wyatt.

Meet the Editor

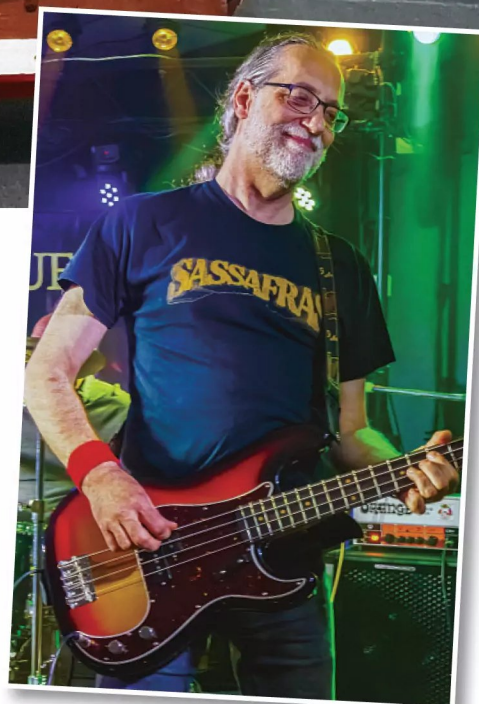


Photo 1: A balsa Clyde Puffer, made when a boy.

I can't remember a time when I was not making models of some sort or other. I grew up with Meccano (mostly passed down from my Dad) and Lego, and graduated to Airfix kits as soon as I could be trusted with a modelling knife. In my childhood, Dad had the entire 'middle room' as a workshop and it was full of radio control aeroplanes, boats and accessories. My equivalent of Proust's madeleines is the smell of nitrocellulose dope and castor oil. It was impossible not to become modeller in such an environment, and my interests expanded to model boats, and I still have a crude balsawood Clyde Puffer that I remember proudly taking to Junior school to give a talk in front of my classmates, **photo 1**. Another talk was on the principles of flight, aided by an aerofoil cross section from one of Dad's crashes. Eventually Dad's workshop ended up in a shed, then a big garage and his interests moved to very large model boats. Somehow, I was allowed to make a small conservatory into a workshop, in which I played radio control boats, electronics, basic metal bashing and, ahem, a few pyrotechnics... I read the odd copy of Model Engineer

that snuck in alongside the usual fare of *Model Boats*, *Aeromodeller* and, of course, *Military Modelling*. The work I saw in ME seemed totally beyond what I could do, unfamiliar with power tools beyond a hand drill. Career wise, my ambition was to be an engineer – specifically, an air accident investigator for the Royal Aircraft Establishment in Farnborough. Possibly seeing so many crashed model aircraft was an influence? It was not to be, I followed a career that saw me become a Chartered Environmentalist, including twenty-five years working with the Wildlife Trusts. Along the way, in my late 30s, I was able to establish my first engineering workshop. This was centred around a Clarke CLM 300 mini lathe. My first major project was, a Stuart Turner (now Stuart Models) 10V. It ran well, although perhaps it deserves a better base, **photo 2**. A second stationary steam engine, from Reeves 2000 castings was the Edgar T. Westbury *Trojan*, **photo 3**.

I found making accessories and modifying my equipment was as satisfying as making models, which led to a series on 'The Mini Lathe' in Model Engineer



followed by shorter articles on modifications to the long-suffering machine, **photo 4**. There are thirty items on my incomplete list of modifications! It was only when two of my models made it into the pages of Model Engineer, that I felt I had finally 'made it'. The first was my model of the *Fradley Canal Crane*, **photo 5**. I consider my stationery engine *Norden*, **photos 6 and 7**, built

Photo 2: Stuart Turner 10V, the classic beginner's model.



Photo 3: ETW's Trojan.

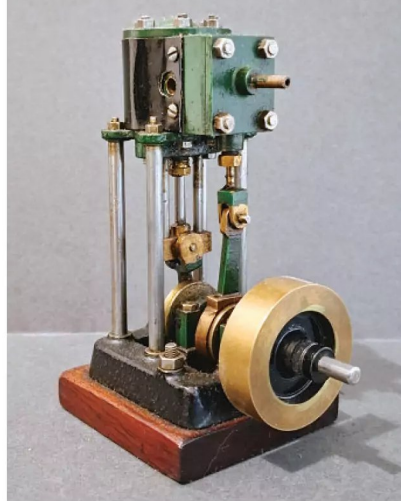


Photo 5: Fradley Canal Crane.



from a sketch in an old issue of ME to be my best model. I had castings made from my own patterns, and I have seen a few models made to my design, which is very satisfying. I later discovered that it is a Chadwick engine, and one significant error was following the old sketch in attaching the slide bars to the cylinder not the frame.

I later had some articles, notably a quick change toolpost and improvements to my X2 mill, in *Model Engineers' Workshop*. In 2014, I took on the role of editing MEW, from issue 215. Like my predecessors, that led to quite a lot of my own work being written up often to cover missing topics, such as my boring head, **photo 8**, and a series on Lathework for beginners.

I was still thrilled when my 3 1/2" gauge diesel outline electric shunter, Southam, appeared in *Model Engineer*, **photo 9**.

I later weathered it, and personally think

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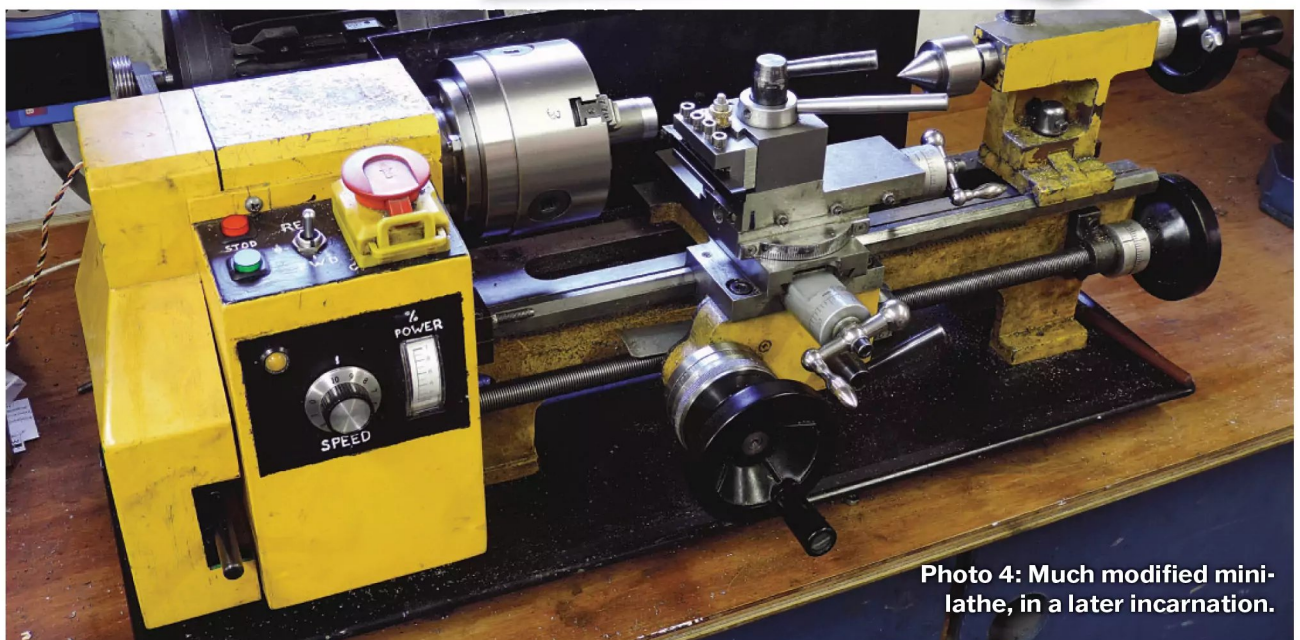


Photo 4: Much modified mini-lathe, in a later incarnation.

Photo 6: Norden on the cover of ME 4452.

Photo 7: Norden on a more realistic base.

Photo 6:

Norden on the cover of ME 4452.

Photo 7:

Norden on a more realistic base.

Photo 8: Boring head.

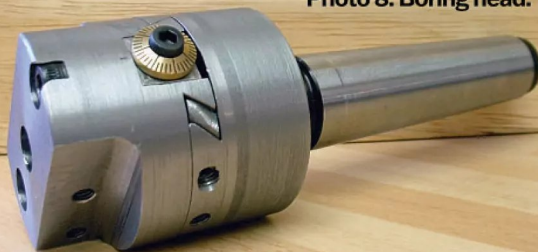


Photo 12: Fluting a tapered column.

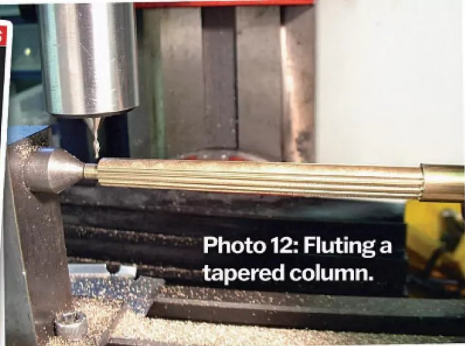


Photo 14: Automaton roller.



Photo 9: Southam on the cover of ME 4541.



Photo 10: Southam after weathering.

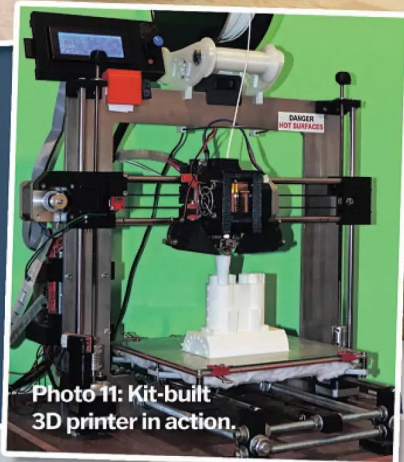


Photo 11: Kit-built 3D printer in action.



Photo 17: 3D resin printed A7V tank, designed in Alibre Atom 3D.



Photo 18: Progress with the 'ancient engine'.



Photo 13: Figuring out the Jovilabe gears...



Photo 15: 66mm refractor with gold and black anodising.

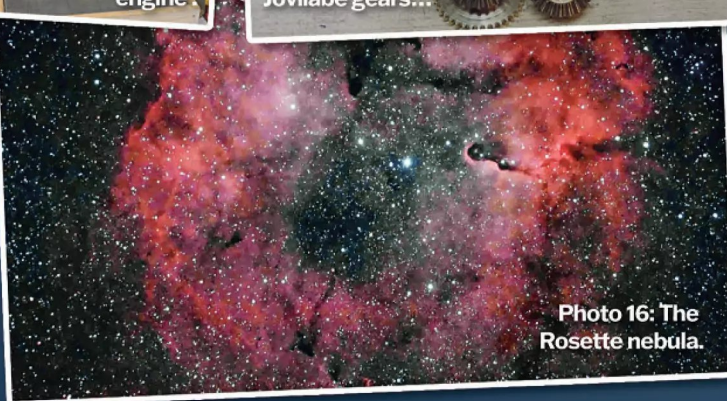


Photo 16: The Rosette nebula.

it looks much less toy-like, **photo 10**. In 2017, I was asked to trial and review a Dremel 3D printer, and this opened a whole new world of modelling for me. If nothing else, it led to me developing my skills in 3D CAD. I still find the way that 3D printed models appear out of almost nothing quite fascinating, **photo 11**. I've continued to work on a variety of models, and my workshop now boasts an SC4 lathe, and is quite well equipped. I am, very slowly, moving forward with Tubal Cain's (Tom Walshaw) *Lady Stephanie* beam engine, **photo 12**, but my stationary engine fascination got taken over by another design from an old engraving of an 'ancient engine'. A minor obsession with gear cutting found me making many parts for a Jovilabe, **photo 13**. Completion of this ambitious mechanism is dependent on me finding a satisfactory way to cut and engrave a

gear some ten inches in diameter. A less ambitious but very satisfying project was a miniature Ransome Simms and Jeffries Automaton lawn roller, **photo 14**. One, more recent, completed project was a telescope specifically designed for astrophotography, **photo 15**. Built around a commercial lens cell, it includes a Crawford focuser with a 10:1 epicyclic speed reducer. As part of constructing the scope, I had to delve into the dark arts of anodising, with surprising success. The scope proved to be excellent for astrophotography, **photo 16**, (one of my other hobbies, along with playing bass guitar). The scope won an unexpected silver medal at the National Model Engineering Exhibition in 2019.

In 2020, I moved in with my father and although I've built a new workshop, various things meant I have not been as active as I would like for a while. Over this time, designing scale models in Alibre Atom and 3D printing them has proven a lifeline, **photo 17**. Sadly my Dad, the inspiration and encouragement for my modelling hobbies, passed away late in 2024. The irony is that I will now have more workshop time, but another change of workshop is likely to be in the offing. Nonetheless, I hope to complete my 'ancient engine' over the next few months, **photo 18**. I hope you have enjoyed this brief review of my modelling interests as much as I appreciate letters and photographs from readers sharing their achievements. 📷



Gerald Martyn builds a locomotive he can lift, continued from Model Engineer issue 4761.

A GWR Pannier Tank in 3 ½ Inch Gauge

PART 11 Valve Gear

The valve gear is Allan straight-link type and follows the full-size layout in most respects. The general arrangement drawing is shown in **fig. 26**. The model valve gear differs from the original in some notable respects. As you already know, the valve proportions come straight from Rob Roy, so port opening is 3/32", lap is 3/32", and we need a total valve travel of 3/8" which is somewhat over scale. A launch type expansion link is used to achieve this travel without too much angularity in the link and much bigger eccentrics. A slight change, too, is that the lowering links are as a pair, like the lifting links, rather than one on centreline as per the original. This is better for lateral stability and for laser cutting. I've done a bit of work to get a good design, with a twice full-size model for aid, **photo 72**. This was used to produce the valve motions shown in **fig. 27**. In full gear this is a reasonable sine waveform and stays pretty good as it's notched-up. Steam inlet occurs close to the required top dead centre

points in all gears, and cutoff is consistent. We never seem to look at when the steam is released to exhaust, just the openings on the pressure side. With this gear the steam cut-off in full gear is 75% piston travel, about as expected but the exhaust port opens at 87% so the much-vaunted expansion is just 12%. At 55% cut-off the expansion improves to around 25% travel (and 31% by steam volume), but release comes forward to 80%. At the release point the exhaust closes at the other end so what is left in that end of the cylinder is now being compressed. These things are inherent in any valve gear with sinusoidal motion and for any given valve travel can only be changed by altering the valve or ports. The blue line in the middling height area is the sum of the eccentric offset from 90° and

the shift caused by difference in the angularity of the rods in crank forward and crank aft eccentric positions. This is roughly equal to twice the valve lap, as it should be, and is the equivalent of the more easily understood motion from the combination lever in Walschaerts' gear. I'm no valve gear expert, by the way. The above observations come

Title	M E Laser Part No	Material	No. Required
Eccentric Rod	28487	2.5mm Mild Steel	4
Eccentric Rod Lugs	28488	1.5mm Mild Steel	8
Eccentric Rod Packer	28490	1.2mm Mild Steel	8
Lifting Links	28489	1.5mm Mild Steel	4
Lowering Links	28491	1.5mm Mild Steel	4
Valve Rod	28493	2.5mm Mild Steel	2
Valve Rod Lug	28494	1.5mm Mild Steel	4
Valve Rod Packer	28495	1.2mm Mild Steel	4
Reach Rod	28498	2.5mm Mild Steel	1
Reverser Plate	28496	2mm Mild Steel	1
Reverser Sector	28497	1.5mm Mild Steel	1
Reverser Lever	28499	2.5mm Mild Steel	1
Reversing Arm	36982	5mm Mild Steel	1
Expansion Link	28534	5mm Ground Flat Stock	2

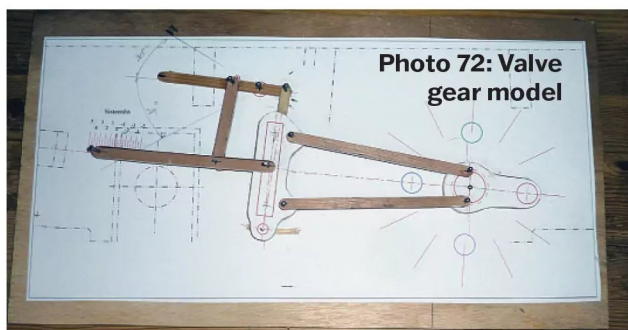


Photo 72: Valve gear model



Photo 73: Soldering the reverser latch.



Photo 75: Finished and assembled reverser

from my review of the motion generated by this gear and the effect it has on steam inlet and release. I found the plotted waveforms far easier to interpret than the sort of valve events diagrams published in books which are, in any case, a derivation of these.

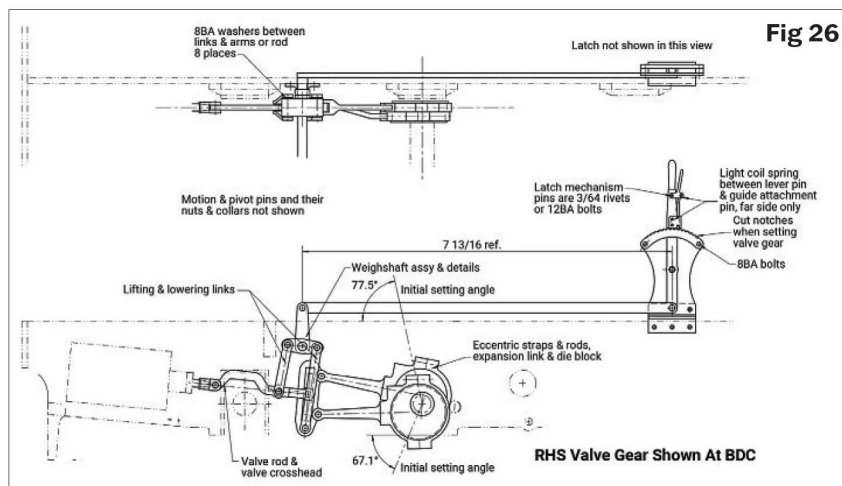
On with the job. The gear makes full use of laser cut parts, with water jet cutting used for the expansion link.

The reverser is a good place to start, and it represents highly visible progress when complete. The stand is offset rightwards on a little bracket made from two pieces of that DIY shop square tube previously purchased, **fig. 28**. The rivets holding the two pieces together need to be countersunk on both faces of the joint, and of course countersunk

rivets are on the unobtainium parts and materials list. Just clip a length from the shank of a dome head rivet and bash it down into the countersunk holes at both ends. File off flush. I reinforced with a little soft solder for luck. My angle had a small internal corner radius so to fit it neatly and square on the frames then a small chamfer on the frame edge was needed. The drawings for the reverser components are **fig. 29**. The laser cut parts just need cleaning up and some holes sorting out. The pivot pins are simple turning and can be fitted, one in the stand and one in the lever, with Loctite and peened over into small countersinks. The one in the bottom of the reversing lever must be filed flush on the rear face. The stand can now be

bolted to the mounting bracket, and here the bolts must be cut off flush on the inside face. For the sector two little spacers are needed and remember the bit about tolerances; these should be just a bit thicker than the reverser lever to allow it to work freely. The lever can now be tried in position and the sector bolted on with the spacers between using 8BA nuts and bolts. Note that quadrant notches should not be cut until valve setting time.

After this rapid progress the latch mechanism is a bit of a shock. Not exactly watchmaking but close, and mostly hand tools are used. The guide block is cut from 3/16" x any width mild steel bar. The trigger, too, comes from 3/16" bar. Note there are slots to make a fork at each end of the base section, with a narrow uncut section between. Without this then there's precious little holding the lever arm piece on. My method was to mark-out the profile, drill the holes, including two to form the radii to the arm, then carefully saw out and file to shape. Slot the forks and finish by thinning and rounding the lever arm. The latch blade is made from a piece of 0.9mm sheet, with a small turned and drilled hinge tube silver soldered on, before cutting to shape. This soldering is just done on a fire brick with no holding required. The flux will push the bits apart but as it melts push them back together with a pointy steel scratching rod and then the surface tension in the solder will help pull them into close alignment **photo 73**. Try not to get solder in the hole! The latch can then be carefully cut to fit; the dimensions are for guidance only in this case. The assembly can be done with 3/64" rivets, or 3/64" rivets threaded 12BA or it will be found that 12BA bolts can be just tapped through with little loss of thread, and nuts can then be put on the back. One on the lever and one on the guide block must be left long to carry the spring. For this latter I used 27 SWG stainless wire wound round a drill shank, **photo 74**. Thinner wire would have been better but that was the best I had. There's no mystery to making this sort of light duty spring. Wind wire round a rod, pull it out a bit, trim to length and bend



the end coils up into loops. The finished reverser is shown in **photo 75**.

The reach rod, is a long thin laser cut part which may need straightening and then just a clean-up and ream the holes 1/8" diameter. Done in minutes, and so obvious I've not shown the drawing. If straightening, then you may notice how easily the rod can be bent. The material is CR4 steel, they say. It has a yield strength (when it starts to bend) of less than 210 MPa, or about 30,000 lbf/in². A reasonable aluminium alloy would have a yield strength around 500 MPa (at one third the weight), and a mid-grade steel for aerospace use around 880 MPa. Steel has an amazing range of properties. In our case CR4 is useful stuff for cutting, shaping and forming, but something better is needed for high strength or high

wear applications.

The drawings for the eccentric straps and rods and for the valve rods are **fig. 30**. I started with the straps, which use the Rob Roy castings and are similar except the thickness is reduced to 3/16", which reduces the rod offset and is a value used by LBSC for models this size, and the bolts are moved apart slightly to improve clearances. It should be possible to sit the bolt heads down flat without resorting to spot facing. My castings came as two pairs, **photo 76**, and I started by milling the top and bottom edges to near size to get some metal off and create a decent datum. Split into single straps and pop each in the 4-jaw chuck on the lathe to clean up one face. The rest is much as previously described for Rob Roy. The 7BA bolts with one size smaller 8BA heads will

just fit in the width, and I found that 8BA washers fitted well too without any extra work. If the hole is not positioned quite right and the bolt head overhangs the edge of the eccentric just a bit, then don't panic. The other side will be OK and so long as the OK sides face each other on each eccentric pair on the engine then no scoring of the adjacent eccentric will occur.

With the strap in the 4-jaw chuck, with the already faced side running square and the hole centred as far as possible, then bore the hole to size, **photo 77**. To turn the eccentrics to thickness, a simple mandrel can be made, just a couple or three thou oversize on diameter, **photo 78**. After use and without removing from the chuck, then skim the mandrel down to eccentric diameter, drill and ream for a centre location pin, and part it off. This will be used on the jig which is essential when joining the rods to the straps to get them all the same length. My parting-off worked fine this time, by the way! The strap outer profile need not be terribly accurate and is best done with hand tools. Those files kept for use on brass will have the metal off quicker than you can say 'rotary table and special fixtures', and the older ones used for steel not much longer.

Ways of making eccentric rods are diverse. In the Rob Roy book it is proposed to machine from solid, but there's a lot of metal for a small machine to remove. Laser cut to profile then machine would make it easier but, as we now know, in thick material the profile will come oversize, so it also needs filing all around. My method is silver soldered fabrication. For this model there are laser cut shapes which reduce the effort. The parts are the rod, which has a hole at the eye end just for locating the other parts, two spacers and two eye ends (lugs), and they can be loosely assembled with a 3/32" and a 1/16" rivet. The 3/32" one through the eye end needs to come out afterwards, so should be well oxidised and coated with typing correction fluid to discourage the solder from attaching, but the 1/16" one needs to be cleaned and soldered in properly. Flux the joints up well and arrange on a fire brick for soldering with Silveflo 55 or similar. When the solder runs through then gently close the joints up with pliers or forceps, **photo 79**, and allow to cool.

Remove the 3/32" rivet and check things out and then cut out the centre locating eye (piercing saw). If the fork ends are not quite right then in this rather soft apology for steel it's easy to correct. When drilling and reaming the eye end holes, care is needed as there's not much spare metal. The one I did while holding the job by hand didn't work too well. **Photograph 80** shows

a better way. My fork eye ends were reduced to 7/32" diameter and though this should be strong enough there is little margin for error. One slip of the file and all is lost. For the final design, then, I altered the overall geometry slightly to allow 1/4" diameter eyes here and at the valve rod. **Photograph 81** shows my finished eccentric rods.

I left the slot in the front of the eccentric straps until I was sure of the thickness of the rods, and then did the cutting by repeated plunging to full depth with a 3/32" slot drill before finally skimming to width. The depth is just within the limits of a standard cutter. The rods are one size fits all as the bent ones need to start out slightly longer than the flat to allow for the bending. So, some metal will need filing off the spade end to get the finished length just right, and this should be done in conjunction with a jig to get them all the same length, **photo 82**. My jig has been used a few times and the bush in the top right of the picture was for my last 5" gauge engine using the same fork-end pin as this time. The bent rod is easy to do in this steel, provided a packer is put between the fork end eyes so they're not squished. As a break with tradition, I fixed my rods to the straps using only Loctite 603. This may seem chancy, but calculated strength of the joint is around 600 lbf so should be adequate. I'll let you know when they fall apart.

The valve rods are made in much the same way as the eccentric rods except that, because the packers are so small, there are little side extension pieces to take a locating rivet that ensures alignment. These are cut off after soldering. The valve crosshead is made from 1/4" or 6mm square bar and looks nicer if the shank is turned to circular with just a slight lip at the front end, as shown, but this is not essential. The crosshead screws against a shoulder on the valve rod and should be fixed with a dab of Loctite, along with the valve nut, on final assembly.

The expansion links should be made from gauge plate, for wear resistance. They are available from Model Engineers Laser as rather super water jet cut parts, but these come at a price and the 5mm thick metric steel will need reducing just a bit in order to fit. For these reasons I've provided a fully dimensioned drawing so you can make at home if you wish, **fig. 31**. In either case the holes need to be reamed and the slot carefully finished to size and made nice and smooth, for which a clean-up allowance is made in the water jet cut part. It's interesting that our usual suppliers only offer imperial sizes of gauge plate, whilst Model Engineers Laser only metric. Hence retaining an Imperial thickness, as 5mm can be

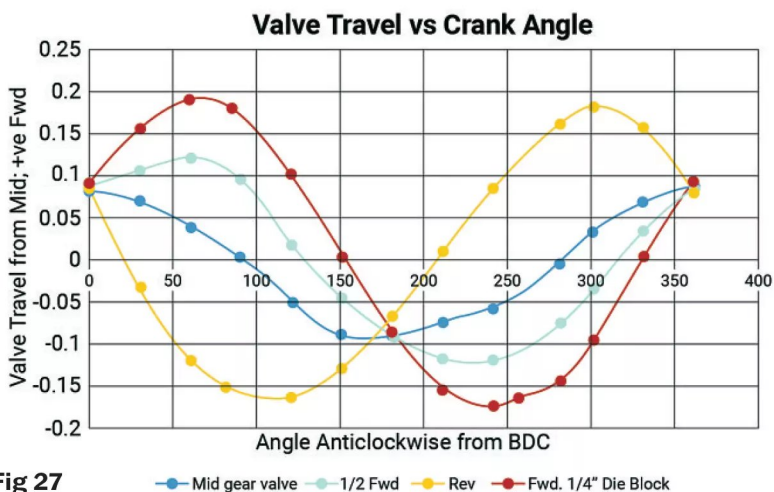


Fig 27

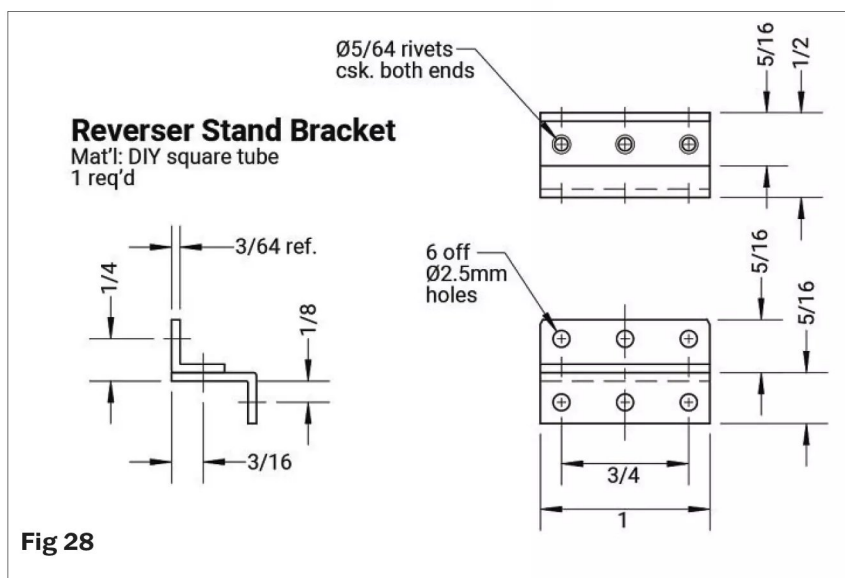


Fig 28



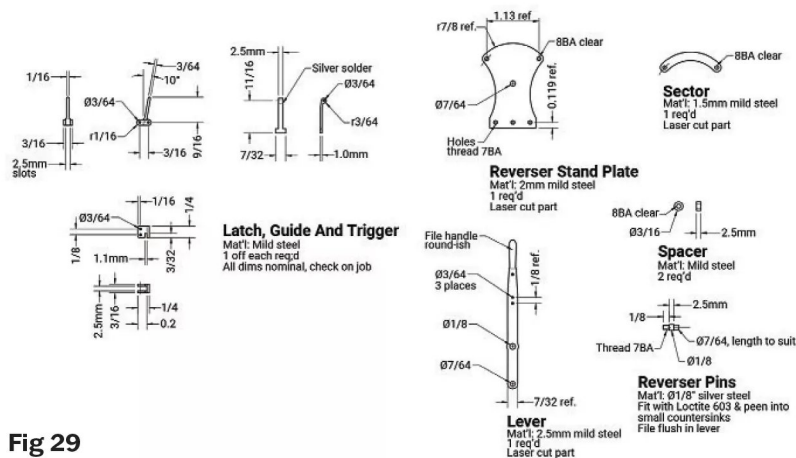


Fig 29

skipped down to 3/16", but making 3/16" up to 5mm is rather more difficult. The die block should be made from phosphor bronze bar, to fit the slot. I have a large chunk of super hard phosphor bronze which I've previously hacksawed bits off to make die blocks using mostly hand tools. This time, in deference to those without such a lump of metal, I used a piece of 3/8" bar, drilled and reamed the hole then squared it up to slightly oversize in the mill before parting-off in the lathe. In all cases finishing carefully by hand is the best way to get a really good fit. Phosphor bronze is notorious for grabbing hold of drills and reamers and holes will often end up slightly under size. The way I deal with this is to make a little 'D' bit from the right size silver steel, hardened and tempered to 'straw' then honed to a really sharp edge, and use it to gently open the hole out to remove those pesky last few tenths of a thou. In



Photo 79:
Soldering a
rod end eye
assembly



Photo 80: Reaming the rod end eyes

any event, the whole job is much easier with a straight link like this than with the curved link in Stephenson's gear.

The lifting and lowering links come as laser cut parts and just need cleaning up, the holes opening up and the short ones bending to shape.

The weighshaft parts and assembly are shown in **fig. 32**. Mild steel may be used throughout, though silver steel could be used for the shaft itself. The job is mostly basic benchwork so making the bits needs little description. Align the lifting/lowering arms to each other using a 1/8" bar through both and use a digital or vernier caliper to set the distances from the shaft ends and fix them to the shaft with Loctite. Then drill the pin holes. I used 3/64" drill shanks for pins, retained in place with Loctite. As I was hacking the reversing arm from solid bar, I suddenly realised it was a missed opportunity for laser cutting, so I've added it to the list, for cutting from 5mm steel, but not tested the result. It comes with legs for workholding while machining to thickness, like the coupling rods etc. The extension boss



Photo 81: Eccentric rods ready for fitting

and pin are separate items and best fixed in place with silver solder, remembering to apply Tippex to areas where solder is not wanted. The reversing arm is set at 84.8° so that the lifting/lowering arms align with the motion whilst the arm is vertical. This angle is derived from CAD and if the important parts have been accurately made then it can be set as stated and without need to measure or adjust anything. The problem is that it is not easy to measure, so I've provided a setting angle across three pins: the shaft, the reversing arm extension boss and a $1/8"$ bar through the lifting arm holes. Simply set the protractor to 73.2° and line up the pins against it. Do it dry, check and double check, right hand end of the shaft, oil holes uppermost, angled forward, then dismantle and re-assemble with Loctite 603, **photo 83**. Finally, when the Loctite is fully set, drill for the fixing pin.

The shaft sits in a couple of simple brass bearings, and they look a bit better if the thickness is reduced a little over the bolt holes and this also helps with clearances. Like Rob Roy, and determined by the cylinder castings, this design suffers from the valve motion being rather too close to the frames and very close indeed to the axle boxes. The whole shaft and bearings assembly goes into the frames together as the shaft is the width of the frames and can't be wiggled in with even just one bearing in situ. On the full size, split bearings were used and the shaft placed onto the fixed lower bearings before caps were put on. This would be rather tiny and overcomplicated in our scale. The front wheelset will need to be lowered slightly to get the countersunk screw in easily and make sure to Loctite the screws on final assembly.

Fig 30

Fig 31

Expansion Link

Mat: Gauge plate with mild steel or bronze spacer/bush
2 req'd

Photo 82: Eccentric rod setting jig

Photo 83: Setting the reversing arm



One drawback of this gear layout is that the pins through the expansion link and die block need to have countersunk screws to ensure adequate clearance. These pins are therefore threaded through 8BA, which is a bit of a heart-in-mouth job but can be done. They need to be either counterbored slightly to allow the countersink to fully sit down, or the screws' threads can be carefully undercut below the heads. **Photo-graph 84** shows this in action using my universal tiny undercutting tool last seen cutting the wheel tyre edges. The countersinks in the links need to be kept small, and when the pins are assembled in the links then the heads can be just a bit proud as there's enough clearance. The pins at the valve crosshead need

The valve gear is best assembled off the model and in accordance with fig. 26, noting the use of 8BA washers on the 7BA threads to give a tight fit for clamping up. Use a little Loctite 248 on all threads to stop things coming undone. This variety comes as a 'glue pen' and little blobs can be put in just the right place with a bit of wire and will not seep through to where not wanted like the liquid stuff does. The parts should pivot on the piece with the maximum area, so, for example, the Loctite used to fix the 8BA screws into the pins through the eccentric rods should be sufficient to ensure the rotation occurs at the expansion link and not in the rod's eyes, and this needs to be

Fig 32

Weightshaft Assembly
 Mat'l: Mild steel
 1 req'd

Pindle Bracket
 Mat'l: Brass or bronze
 2 req'd

Lifting/Lowering Arm
 Mat'l: Mild steel
 2 req'd

Reversing Arm
 Mat'l: Mild steel
 Arm made from bar or laser cut
 1 req'd

Fig 33

Lifting/Lowering Pins
 Mat'l: Plain section Ø1/8 silver steel
 (length includes recommended clearance allowance)
 Drill through Ø2.5mm
 Fix length of 7BA studing using Loctite 603

Rod Eyes Pins
 Mat'l: Plain section Ø1/8 silver steel
 Thread through 8BA
 x 2 8BA csk. screws
 6 req'd
 Check fit on job

Valve Crosshead Pins
 Mat'l: Plain section Ø1/8 silver steel
 Drill through Ø2.5mm
 Fix 7BA bolt with thinned head using Loctite 603
 2 req'd

Valve Motion Pins



Photo 84: Undercutting an 8BA screw head



Photo 85: Valve gear sub-assembly

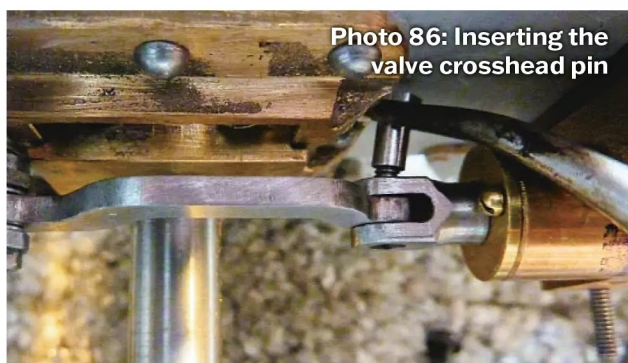


Photo 86: Inserting the valve crosshead pin

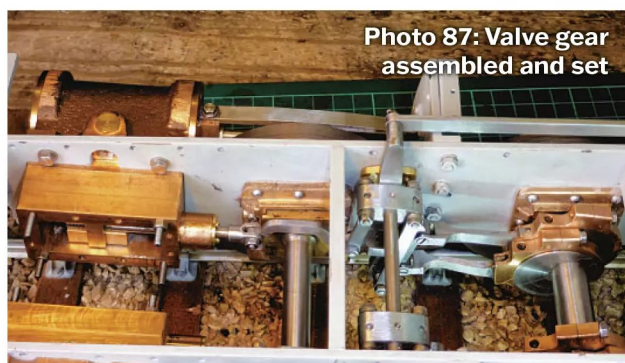


Photo 87: Valve gear assembled and set

checked. One side ready to assemble to the weighshaft is shown in **photo 85**. When everything is together then jiggle it all into position (fiddly, more fingers needed, but it will go in). Put the fixing screws into the weighshaft bearings and have the eccentric straps rear portions at the ready.

Valve setting is a bit like Rob Roy and one advantage we share is that launch-type expansion links give very little interaction between the forward and reverse motions when in full gear, which makes the process easier. Packers are needed under the axle boxes to raise them to the running position; something around 14SWG (2mm) is about right. One side should be completed at a time, and the eccentric straps need to be held on the eccentrics by hand until the rear strap portions are fitted near the end of the process. Find piston top dead centre positions each end and mark the frames and driving wheel flange somewhere so the positions can be repeatedly and quickly found. Set the eccentrics in about the right place using an Allen key in the grub screw aligned to the angles shown in **fig. 26** and tighten the screws a bit. Connect up the valve rod to the crosshead with a simple and easy to remove pin as it will need to come out a few times for sure. Put the reverser to full forward. Rotate the wheels forward and it will kick back to a position where the gear will operate. Mark the sector

and stand and cut a notch for the latch blade. Do the same for rearwards (always rotate the wheels backwards for reverse gear setting). Put the lever in the centre position and, again, cut a notch. Cut more notches to divide the blank bits of the sector; halve and halve again worked for me. Put the gear about half forward (as this seems to work best) and rotate the wheels, watching the valve cross the ports and adjust via the valve spindle to give equal opening at each end. The resolution available is one half turn of the 40 TPI thread, so about 0.012", which is not too wonderful but has to do (as with Rob Roy). Now with the reverser fully forward rotate the wheels and observe the port opening. Adjust the forward eccentric to make the ports just start to open at top dead centre, rear port for crank to the rear, and front for front. Again, best that can be managed will have to do, and maybe try a half turn either way on the valve spindle to check for any alternatives. Reverse setting uses the same process, turning the wheels backwards of course. Now check things at all reverser positions and ponder on any final adjustments. The valve should open at top dead centre, perhaps advancing a little as the reverser moves towards mid gear. At mid gear there should be no opening at all, just, but there will probably be a slim crack one end of the travel or other because of the limited setting accuracy.

Valve opening in full gear may be a little biased, with more at the rear than the front. This does not matter as the important events are through the mid travel. As the reverser is moved towards mid then the valve opening will reduce, and the ports will close earlier. When everything is as good as can be for both cylinders then tighten the grub screws and fit the eccentric strap rear portions and re-check everything. Now have a long sleep or two (well I did). When rested and happy, remove the strap rear portions and drill into the axles through the 3/32" holes in the eccentrics and fit permanent pins using Loctite. Relying on the grub screws alone risks movement in use. The last job is to fit the proper pins into the valve crossheads, and finding that the cutout in the horn really is needed, **photo 86**. Artery forceps, as used here, are easily obtained via the internet and indispensable for putting pins and rivets and things into awkward places.

The finished gear proved rather hard to photograph and **photo 87** is my best attempt. I'll say at this stage that my model is being developed as quickly as I can to prove the design before publication, so I didn't try too hard to get a super finish on the valve gear parts that are all going to be pretty hard to see (and photograph) when finished.

To be continued.

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Machining Gib Strips



It's a tricky job to machine gib strips accurately. This tip from David George is a way of holding them secure I haven't come across before so he wins this month's Chester voucher.

When I machine gib strips I hold the female fixed part in a vice or clamp it down and using the gib adjusting holes or bolts etc. to hold the new strip in place whilst the edge is milled to correct angle and depth. Turn it over and complete the other edge to finished width. I always use a round rod to press the strip into the angle.



Please note that the first prize of Chester Vouchers is **only available to UK readers**. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.



Paul Zeusche, made the strake moulds last month, to conclude he casts the strakes and completes the plain tyres.

Photo 11: Assembled and filled moulds, PU visible in vent tubes.

Casting Polyurethane Traction Engine Tyres and Strakes

PART 2

All mould surfaces need to be thoroughly waxed prior to every use using a paste wax or other compatible release agent. The steel inserts need to be thoroughly cleaned to get rid of any traces of oil etc. before spraying with two coats of either unwaxed shellac, available in a rattle can or a specific primer now available from the manufacturer. I set these up on a series of vertical dowels and stuck a circular self-adhesive 'dot' over the exposed threaded through hole to prevent PU filling the insert. Gloves should be worn after cleaning to avoid contamination.

In **photo 10** you will notice some inserts have a flat cut off on one side as I failed to notice how close the insert would be to the taper at the side of the strake in some locations. This only became evident in the trial strakes where inserts were visible in the translucent product used.

The placement of the inserts within the mould is critical so that it exactly matches the predrilled holes in the steel rims. These are held in place on the male mould half with a round head cap screw from the outside of the

mould. One way to ensure this is to use the two plugs from the female mould after the male side has been finished and locate these on the rim coinciding to the lines on the paper strip used for the hole locations and clamp in position. Drill through the holes from inside the wheel clear through the wooden plugs.

Replace these in the female mould, apply some double-sided carpet tape to the exposed surface and reassemble the two mould parts, then carefully separate the parts leaving the plugs stuck to the male half, drill through the holes in the plug to pass through the mould. If done carefully

this should accurately locate the insert positions within the strake to coincide with those drilled in the wheel rim.

With the mould thoroughly waxed and inserts in place, it can now be bolted together and the PU prepared for pouring. Using digital scales carefully weigh the estimated amount of parts A and B and hand mix thoroughly to avoid



Photo 10: Degreased inserts ready for two coats of unwaxed shellac, three inserts per strake have a partially trimmed edge to maintain clearance on tapered strake side (my mistake).

Photo 12:
Fill funnel
and small
amount of
PU removed
after cure.



Photo 13: Finished strakes, the
underside to the right, inserts with
vent and fill locations visible.



Photo 14:
Completed
wheel with
strakes
attached.



introducing air into the mix; finally add the black colouring agent and continue mixing to an even black colour.

Using a small plastic funnel pushed into the fill point and two short pieces of 5/16" diameter clear plastic tube in the vent holes in each strake, fill the cavities through the funnels until the PU appears in the vent tubes. The assembled mould should be tilted so the vent tube is at the highest corner to avoid air pockets, this will require some

adjustment during filling, **photo 11.**

After the first pour, recalculate the revised amount of mixed PU you will need for each pour, leaving a little left in the funnels and vents. There is a tendency for the PU to settle before cure so leave a small reservoir in the funnel to maintain a full mould. The residue for the eighty-four strakes I moulded was a little less than 2lbs total, or about half an ounce per strake.

Depending on the intervals between uses it is wise to displace air from the catalyst container using the Extend-it dry gas product available from Smooth-on.

Once the pour is complete, transfer both filled moulds still with the fill funnels and vents in place into the hot box, close the box with the fan and light on and leave undisturbed for twenty-four hours. The next day remove the fill funnels and vent tubes with a

Photo 15: Base with routed grooves completed and centre locating 'puck' in place.

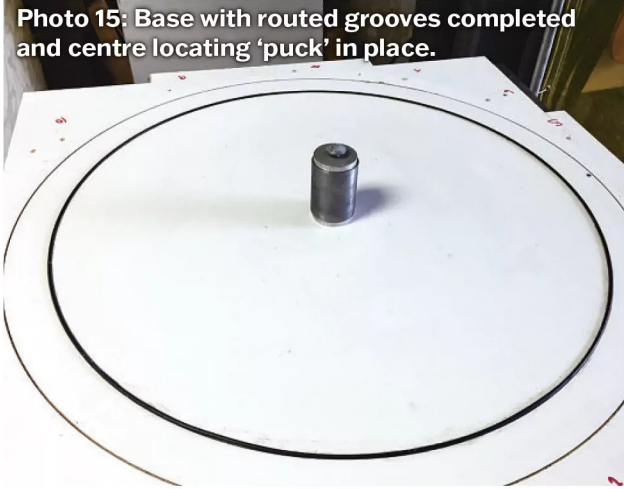


Photo 16: Outer Formica former in place showing numbered support brackets.



twisting motion, the parts can easily be removed from the mould after it is disassembled and the whole process including waxing repeated. I epoxy glued a simple wooden support under the mould on the female side to hold it level while in the hot box.

The remaining cured plug of PU can be pulled/pushed from the funnel and the vent tubes discarded once removed, **photo 12**. The completed strakes will release from the mould while still attached to the male side, **photo 13**.

With some advanced preparation this can be repeated each day to yield four strakes (two per wheel) and the actual process takes less than an hour. It would be wise to make several spares from any leftover PU as it has a relatively short shelf life once exposed to air. Follow all manufacturers recommendations in this regard.

FINAL ASSEMBLY:

With the wheels at the paint primer stage the rims should be painted gloss black before installing the strakes, I added a light smear of Sikaflex 522 or equivalent polyurethane compound to the strake surface and

entered the round head cap screws from inside the wheel with a dab of Sikaflex on the thread. Tighten these firmly, but not enough to disturb the insert within the strake, clean off any squeeze out immediately.

The round head fastenings holding the strakes in position will need their hex key drive cavities filled and primed before final paint, so adequately protect the installed strakes until ready for final assembly, **photo 14**.

SOLID TYRES

Solid tyres are a somewhat simpler procedure, the following method is proven to work so change it at your own risk. The main precaution is to ensure there is absolutely no chance of the PU leaking before it cures, in a large wheel there may be considerable head pressure on the outer form and on the seal around the wheel rim.

The basic set-up is a melamine faced piece of MDF as the base, and a length of Formica set vertically in a groove to form the outer edge of the tyre, supported at intervals on the outside by wooden brackets tangent to the form and screwed securely to the base. These should be numbered to match

the base as they will be reused for the second wheel. Inserts were added to the wheel rim as a precaution, welded staples made from 1/4" bar could easily be substituted and spaced about every 5" or so.

The wheel is first placed centrally on the base and the amount of gap checked. The seal between the wheel rim and the base must be effective. Assuming it is not wildly out, mark the outside of the rim on the base and through the hub to establish the centre of the wheel, **photo 15**.

Drill a small hole at the centre and using a router on a circle cutting arm and a 1/4" cutter cut a 1/16" deep groove very slightly smaller than the wheel rim, this will locate a 1/4 x 1/4" strip of self-adhesive weather strip that the wheel rim will compress to form a seal. If the rim is uneven enough that 1/4" weather strip won't suffice use a thicker strip so there is no chance of a leak.

Using the same centre, reset the router and change the cutter to 1/16" to cut a second shallow groove (1/8" deep) offset from the wheel rim by the thickness of the tyre required. A 1/16" foam 'O' ring will seat in this groove to ensure an effective seal to the Formica ring forming the outer diameter.

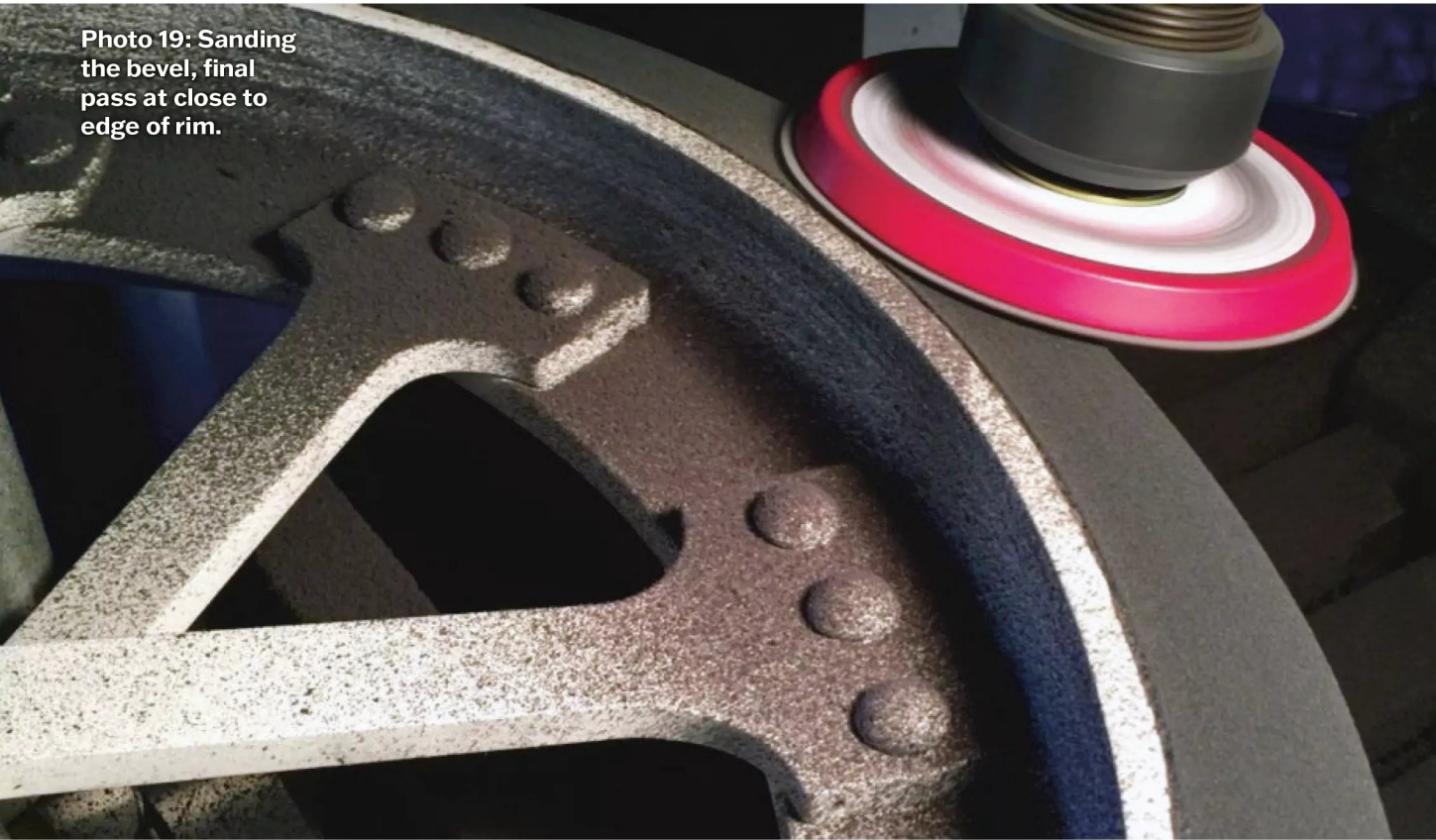
Photo 17: Assembled and ready for the pour, note weather strip on top of rim.



Photo 18: Last of 3 mixes being added to the form, eventually to top of weather stripping.



Photo 19: Sanding the bevel, final pass at close to edge of rim.



Turn a close fitting wooden or metal locating centre for the wheel with a central hole for a bolt. Enlarge the router centre for the bolt and secure this firmly in place through the bolt hole.

The Formica ring material width can now be determined. Push an offcut into the outer groove and measure the height of the wheel rim, add about 3/8" to this and cut a long strip of Formica to width and preferably long enough to reach around the full circumference without a join, though with a large wheel this may be difficult.

If a join is necessary, trim the ends square and clamp to a bench or similar and glue a 2" to 3" wide offcut across one end using five-minute epoxy. Hold the bottom up 1/8", glue this to the back or non-shiny side of the Formica.

Trial fit this in the groove to establish the circumferential length and cut this square across with a little clearance. To ensure the form is square to the base make enough wooden brackets to allow one every four to five inches of circumference, these can be L shaped in cross-section formed by a piece of 1/2" thick wood glued to a wider piece, the long side (height) should be 1/4" shy of the width of the Formica and the short side wide enough for a single screw. These can be left square as I did or cut as triangles.

Locate the brackets tangentially to the Formica strip and drill pilot holes

for a screw through the narrow leg and into the base. Open those in the bracket to larger holes, apply some five minute epoxy to the long leg and clamp or otherwise hold the Formica to the bracket until the glue sets. Screw the bracket to the base using the pilot hole. Once all the brackets are placed, glue the joint together while ensuring this is square to the base. Place a supporting bracket each side of the join. With some care this will produce a perfectly round tyre mould concentric to the axle, **photo 16**. Lastly, number each bracket and its position on the base for future use.

With the wheel removed thoroughly wax the entire area bound by the future tyre, that is between the two routed grooves and also the Formica outer former. Force paste wax around the inner edge of the Formica for good measure.

Set the wheel seal in its groove; wipe a little paste wax over this as well before seating the wheel in place over the locating puck. The wheel should be held down securely with short pieces of wood screwed or bolted down in three or four places around the inner perimeter. This must compress the weather strip enough to ensure it won't leak PU, **photo 17**.

As the PU will likely settle slightly as it cures, stick another 1/4" thick self-adhesive weather strip evenly around the

top of the steel wheel rim. The Formica rim and top of the wheel weather strip should now be more or less the same height. The base and installed wheel should be supported on sturdy saw horses or similar, preferably outside in a sunny location, and levelled up carefully with shims as necessary.

For even a small front wheel it will take a large amount of mixed PU, the volume can be calculated by the following formula where R = radius of Formica, r = radius of wheel, h = height of wheel to top of weather stripping:

Volume in cu ins = $(\pi \cdot R^2 - \pi \cdot r^2) \cdot h$
 For instance: wheel diameter of 15", a 2" thick tyre for an outside diameter of 19" and a width of 3-1/2"
 $= (3.14 \cdot 9.52 - 3.14 \cdot 7.52) \cdot 3.5 = (283 - 176) \cdot 3.5 = 375 \text{ cu ins} = 1.35 \text{ imperial gallons}$

Add about 2% for mixing loss and shrinkage, rounded up to 1.38 gallons of mixed PU as a guide.

(In metric use measurements in millimetres and divide by 1,000 to get a volume in millilitres, or 1,000,000 to get a volume in litres).

It is important that the entire quantity of required PU should be pre-measured with consistent colouring for each batch and be hand mixed and poured into the form with the minimum of time between each mix to avoid layering, assistance will be needed for this so at least a second person to help will be essential. If

you are power mixing be very, very careful to avoid introducing air into the mix.

Above all, be well organized so no time is lost between mixed batches being poured into the form, **photo 18**. Once the last of the material is poured to the top of the weather strip and/or the Formica outer form adjust the level of the base if necessary to true level.

Once satisfied, cover with black plastic held away from the poured surface. Leave it in bright sunshine and undisturbed for the rest of the day (Ed's note – Paul gets over 50% more sunshine on the US West Coast than we do in the UK). It can be moved to a warm location at the end of the day. An early start will ensure an adequate post cure.

Allow forty-eight hours for a full cure and if satisfied remove the outer Formica band by undoing the securing screws in the brackets and manually flex away to free the band so it can be removed fully intact.

The wheel and cast tyre can be lifted off the base by whatever safe means, a 19" diameter wheel will now weigh in excess of 60lbs. A full-size wheel obviously considerably heavier.

Disassembled, the wheel edges should be bevelled and the corners rounded over. The lower edge against the base) will be close to the very edge of the rim. The top should be above the rim by the thickness of the weather stripping used and will most likely be uneven and possibly have small air bubbles. I am fortunate to have a powered rotary table and a large enough mill to mechanize this to some extent, without this another method will need to be figured for whatever equipment you have.

The base can be reused for this

option, remove the wheel and cut away the weather stripping from both edges. Cut a Formica disc or two as spacers to drop over the centre pin, return the wheel to the base. With the spacer in place it should rotate about the pin easily with a little grease or oil.

Determine the bevel you require and set up the wheel/base at an angle to rotate easily around its centre, figure out something to rotate the wheel at a slow and consistent rate. This could be as simple as a slow speed drill with a 2" sanding drum to act against the outside of the tyre. The drill press or mill should drive a flat hard disc with 24 or 36 grit sand paper rotating at moderate speed and against the rotation of the wheel.

Set the wheel in motion and adjust the depth of cut incrementally after every second full rotation until it is just clear of the rim edge. More will need to be removed from fill side so do this first. Avoid stopping the rotation with the sanding disk still in contact otherwise you will create a divot in the side.

The outer corner can be rounded over using a hand-held drill and smaller disc while the wheel is rotating and finished off by hand held sandpaper, **photo 19**. For my front wheels a 1/4" bevel each side looked about right reducing the outer width to 3", I have yet to complete the corner round over in the photo.

Flip the wheel over and complete the other side and the tyre is finished. With the setup reassembled and waxed the other wheel can be completed, **photo 20** also see photo 1.

MISCELLANEOUS SUPPLIES:

Assuming you have at least basic workshop equipment, the following less

common supplies will be needed. The mould related products can be sourced from fibreglass suppliers or a friendly fibreglass boat/builder locally

1. Release agent: Common mould release wax is pretty much foolproof, typically a semi-hard paste wax applied with a rag or paper towel. On new surfaces use 3 coats to establish a build-up.

2. Fibreglass cloth and Chopped strand mat (CSM)

3. Vinylester resin and catalyst/ Epoxy resin and hardener. Relatively small quantities required Allow one catalysed pint +/- per mould

4. Reinforcing (rigid) foam, 1/4" ~3/8" thick, polyurethane in sheet form if using vinylester resin, rigid polystyrene insulating or polyurethane foam if using epoxy.

5. PU compounds, from Smooth-On or others.

6. Bench top grade Formica and Melamine faced MDF, builders supply or cabinet makers for off cuts.

WAS IT WORTH IT?

All this work was completed before Covid and resulting material price increases, but even now at current material costs it produced a full set of strakes and tyres for considerably less than commercially quoted, at least in my location (Upper west coast USA). Labour is entirely my own and there was a learning curve too. The above procedures yielded a very satisfactory result without any failures and was completed entirely in my workshop and at my own pace and without the inconvenience and cost of transport to and from a distant vendor. 🍷

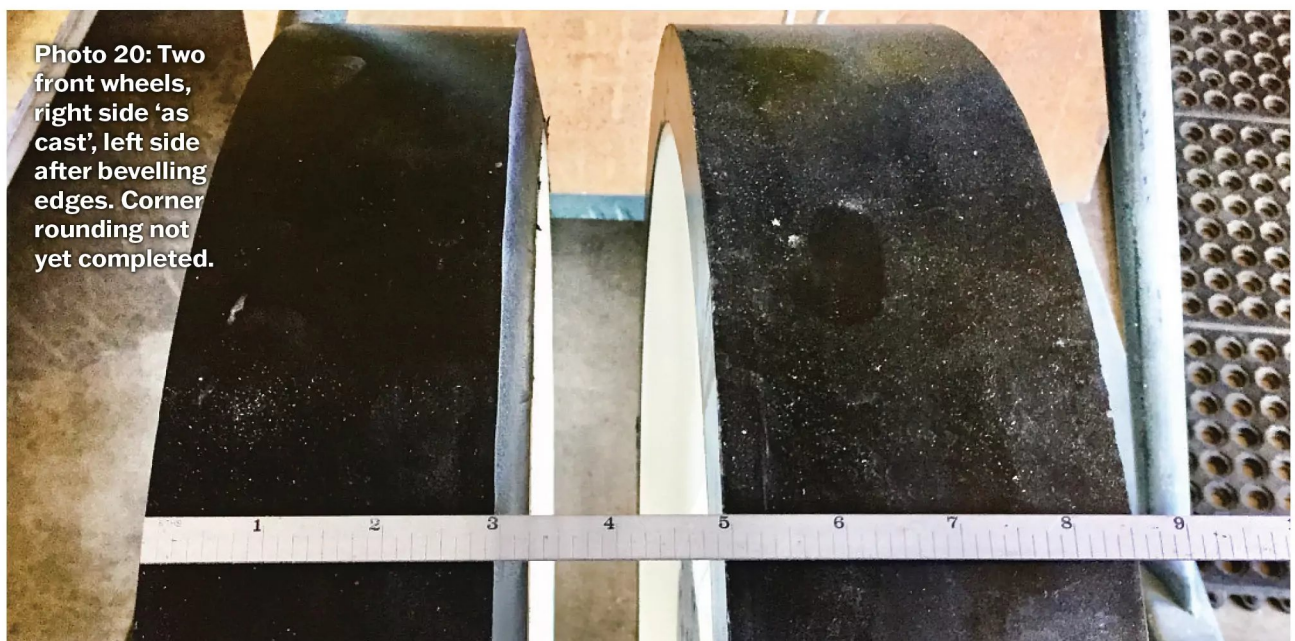
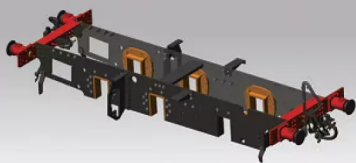
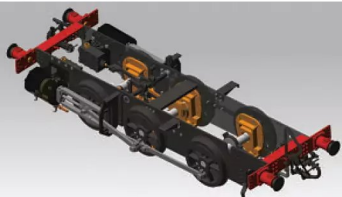


Photo 20: Two front wheels, right side 'as cast', left side after beveling edges. Corner rounding not yet completed.

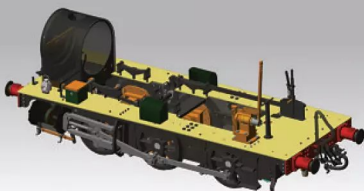
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- Lubricator
- Silver soldered copper boiler
- Multi-element semi-radiant superheater
- Reverser
- Boiler feed by axle pump, injector, hand pump
- Stainless steel motion and grate
- Sprung axle boxes with needle roller bearings
- Etched brass body with rivet detail
- Safety valve
- Painted and ready-to run
- Pressure Gauge

Approximate Dimensions

Length: 686mm Width: 241mm
Height: 318mm Weight: 35kg

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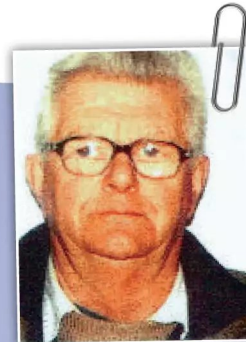
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Photo 1: The tiny oil can.



A Miniature Oil Can

Peter Evans describes a charming oil can which can be made as either a model accessory or as a bit of fun for practical jokers.



These are a few notes on the making of a small working oil can, **photo 1**, which was not only fun to make but also proved a talking point for quite a few model engineers later on.

Many years ago I had made a small model oil can for my 5" gauge De Winton vertical boiler loco. This was bolted onto the toolbox lid. It did not contain oil, but the lever was spring-loaded, so it did look pretty realistic. Of course the usual club wags had to press the lever up and down, then announce to all that it did not work. With this in mind I thought a working one would be more of a challenge.

The later version, **figs 1 and 2**, was similar as it had a main body using a piece of commercial 3/4" copper water pipe, with a flat copper disc base soldered on the bottom. The top was turned from solid brass to my own drawing dimensions. The top cap must be a good push fit onto the top of the main tube body so you can remove to fill it, then replace with ease, **photo 2**. It must not be too easy otherwise it could fall off. The pump body inside, was again brass and there are two bronze or stainless steel balls seated inside. The pump components need to be a good sliding fit as there are no seals present.

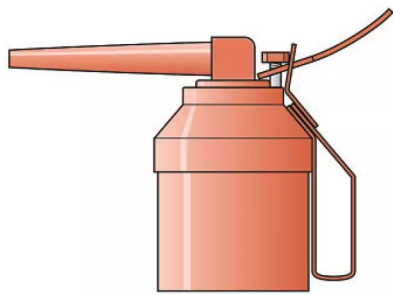
The long spring on the outside came from a ball point pen and the handles and so on were all made from bits of scrap brass strip, **photo 3**. I did silver solder it all together for strength, but I am sure it could just as well be soft solder instead. In the end, this build proved to be quite easy, and I was

amazed that it worked so well for something so small.

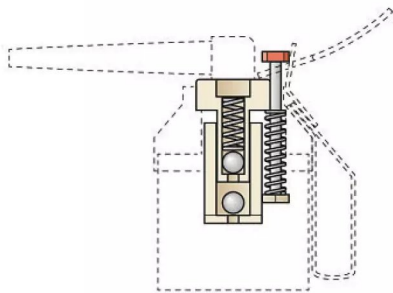
It was at this point that a new idea came to mind on how I could get my own back on the club wags. The idea entailed blocking up the normal outlet, drilling a quite small hole at the rear by the handle and filling the can with water



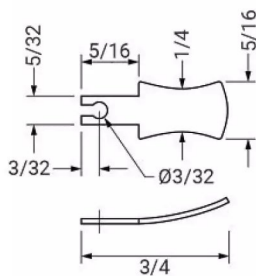
Photo 2: The various parts, dis-assembled.



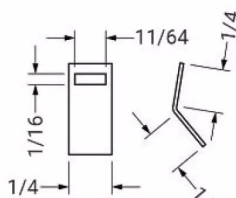
Small Oil Can
By Peter Evans



Detail Of Assembled Pump

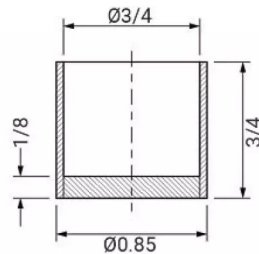
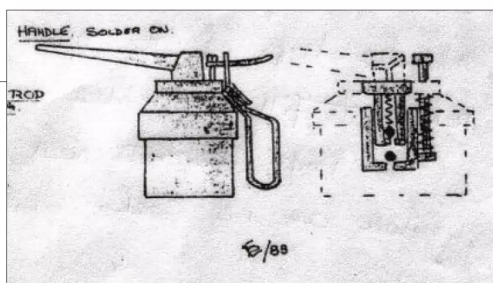


Trigger
Mat'l: 0.030 steel

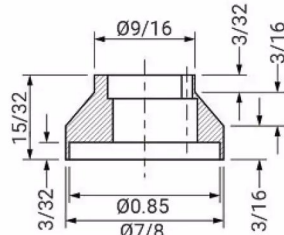


Trigger Pivot
Soldered in place

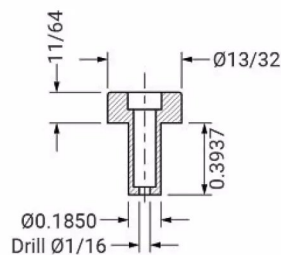
The pump outer must be a good sliding fit on the pump inner
The cap must be a push fit onto the body



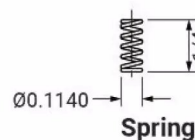
Body
Mat'l: Copper



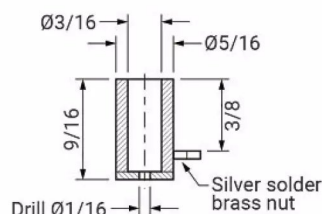
Top Cap



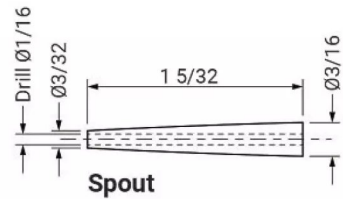
Pump Inner
Silver solder into cap



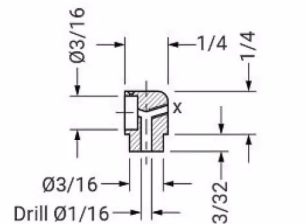
Spring



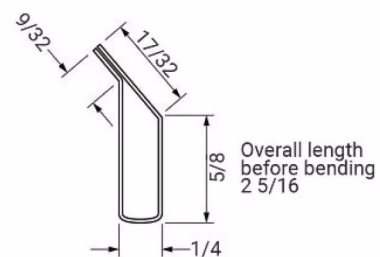
Pump Outer



Spout

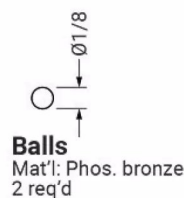


Spout Mount
Rear hole 'x' tapped for blank when not req'd

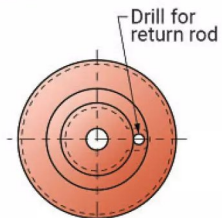


Handle
Mat'l: 1/4 x 0.020 brass
Soldered in place

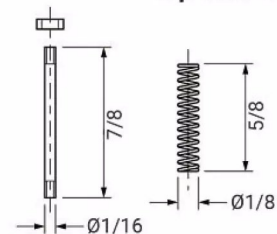
Overall length before bending 2 5/16



Balls
Mat'l: Phos. bronze
2 req'd



Top View Of Top Cap



Return Rod And Spring

The body is from Ø3/4 bore domestic copper pipe
All components are brass unless stated otherwise
Most other parts need not be accurate
The Springs come from ball point pens

Fig 1: Construction of the Oil Can.

Fig 2: An excerpt from Peter's original drawing, which beautifully executed but rather difficult to reproduce clearly.

instead of oil. This way the first unsuspecting person to press the lever would just get a jet of water squirted straight up their arm.

The old original oilcan was duly taken off the toolbox and the newly doctored version fixed in its place. A bit of briefing at the club saying I had made a new oilcan, but do not touch. Then a few seeds planted in general conversation before waiting for one of the club wags to show up just to see the new addition. Usually they can't resist a try, which I have found is made even more enticing if accompanied by a 'please do not touch'.

On its first outing there was quite a gathering in the steaming bay which is pretty normal. Then one of the usual wags approached having been told in the clubhouse about a new oilcan. He arrived muttering something about another non-functioning oil can. No, "do not touch" I said. Which usually just falls on deaf ears. However this time when the lever was pressed the jet of water was squirted up his arm, this was accompanied by total silence from the recipient. Then roars of laughter from those watching that could be heard all over the steaming bay. It was at this point that somebody was sent off to find another innocent victim for another go.

I can honestly say it is simple to make and has caused a lot of fun, well worth the effort. It will of course pump oil, but clean water is much more fun. If you try making one, I am sure you will get a load of fun as well. Whenever I take the loco to the club I am always asked if there is water in the oil can and then they are off to find a new mug that is unaware of his fate.

It always amazes me that a small item like this can be such a focus. The loco

that took a great many hours to make is ignored. It is small items like this that often get all the attention.

I will admit that in this case it was worth all the effort, just to see the amount of laughter it has created. The magic words "do not touch" always makes it certain that they will try when they think nobody is looking. I can also say that the amount of water that one press sends out is amazing for such a small pump. ●



Photo 3: A close up of the top showing how the parts fit together.

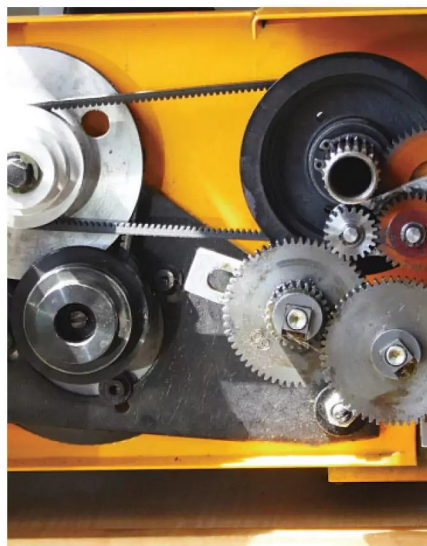
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PART 5

Working on the Lathe: Drilling and Boring

In this instalment of our beginner's series, **Neil Raine** looks at stability and drilling in the lathe.

Drill bits are brittle tools and have a high length to breadth ratio. Smaller drill bits are particularly at risk of flexing and snapping under load. This is why it is so important for the drill bit to be aligned central to the axis of rotation, so that the load is distributed along the length of the tool. Turning the tailstock hand wheel applies a compression force along the drill bit. The size of the rotational force (torque, lb/ft) applied to the tailstock hand wheel determines this force which is one determinant of the feed rate. Other determinants include the geometry and sharpness of the tool. When all of these forces are not well balanced, the likelihood of experiencing problems increases. One example is applying too much pressure to advance a dull drill bit; it is unable to progress through the work fast enough and snaps under the strain.

The first sign of instability when drilling is movement of the drill bit. This will often be seen upon initial contact between the bit and the work. Small diameter bits will flex in an oscillating pattern, greatest at the midpoint. Should this occur, it is unlikely to

resolve, and it is better to investigate the cause before proceeding. When the drill bit is precisely aligned to the rotational axis of the lathe there should be no movement visible. If misalignment is suspected, the work can be faced again and the tip of a centre drill brought into touching contact only with it, similar to making a scratch pass. If this creates a circle

scribed onto the work, the most likely cause is misalignment in the x axis between the tailstock and the axis of rotation. This test will also show the amount of lateral misalignment, equal to the radius of the impression left on the work. Once known, this is easily corrected by adjusting the position of the tailstock on the lathe bed. The conical 60° countersink made in

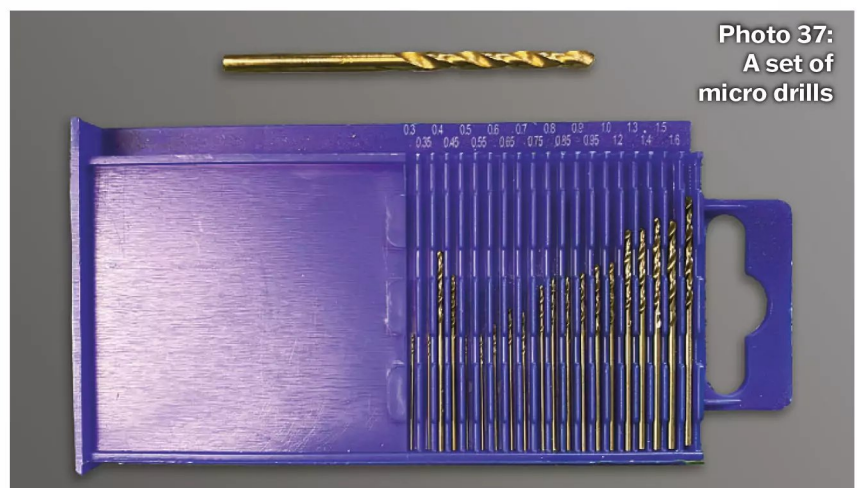


Photo 37:
A set of
micro drills



Photo 38:
A miniature
'bicycle
crank'.

the work by the centre drill is a good match for the angle of a tailstock centre, photo 27 (note, references not in bold type were given in earlier instalments). However, it is a less precise match for the tip of a typical twist drill bit that has a point angle of 158° (Ed's note – using short-shanked spotting drills instead of centre drills is a good way to avoid this problem). Nevertheless, the lips of the twist drill bit are stabilised by contact with the countersunk cone in the work, photo 28. Where possible, it is best if the countersink is slightly larger than the diameter of the subsequent twist drill bit, ref. 2. After the twist drill bit becomes embedded into the work in the parallel bore, stability is increased further. Continued stability of the bit when drilling on the lathe is not guaranteed and there are a number of threats to this including: misalignment of the tailstock; particularly narrow drill bits (e.g. micro drills, **photo 37**; particularly long drill bits; incorrectly ground drill bits; blunt drill bits; excessive compression force or feed rate; and excess speed. Many of these risks can be offset by good planning, refs 18, 22. When drilling on a manual (non-CNC) lathe feedback from the cutting

performance of the drill bit is felt through the hands operating the tailstock handwheel. As the size of the drill bit reduces, so does the feedback of vibrations sensed through the hands. Because of this, there is a greater risk of applying too much pressure to the drill bit causing it to break, **ref. 26**. This is a common problem and there are good solutions in micro sensitive drilling attachments such as that marketed by Myford, UK for 0.3 to 4.0 mm drill bits, ref. 14, and other manufacturers. Myford also

originally offered a lever tailstock attachment (part number 1440, ref. 3), now out of production. This is not to be confused with the micro sensitive drilling attachment.

The micro sensitive drilling attachment is a Jacobs chuck fitted with a sliding lever operated mechanism to enable the fine control of movement and force applied to the drill bit. There is also the option to self-build a drilling attachment based upon this principal, **ref 26**. Clock and watch makers and repairers are familiar with micro drills, **photo 37**, and some solutions to the problems using them likely originated in the industry. Another solution to prevent drill bit flexing is to support the bit close to the work. The bit is passed through a drilling guide that must be precisely aligned with both bit and the axis of the lathe and secured close to the work.

ECCENTRIC DRILLING IN THE LATHE

So far, discussion about drilling on the lathe has concentrated on achieving precise concentricity between the rotational axis of the lathe, the bore and the cylinder wall of the component. Mostly, this is exactly what is needed, but there are occasions when a precise bore, or sequence of bores, is required other than in the centre of the component. Such eccentric bores can, of course, be made using the pillar drill or the milling machine. If a sequence of evenly spaced bores is required around the circumference of a part, the angles may be measured manually. Otherwise, some type of indexing facility will be needed to accurately and evenly space the bores. When using a pillar drill or a milling machine, a rotary table with an appropriate work holding device will be suitable, though indexing plates may also be needed. This tool is another expense, however, that might not be justifiable.



Photo 39: Various
eccentric drilling
test pieces.



Photo 40: Drilling using the offset method.

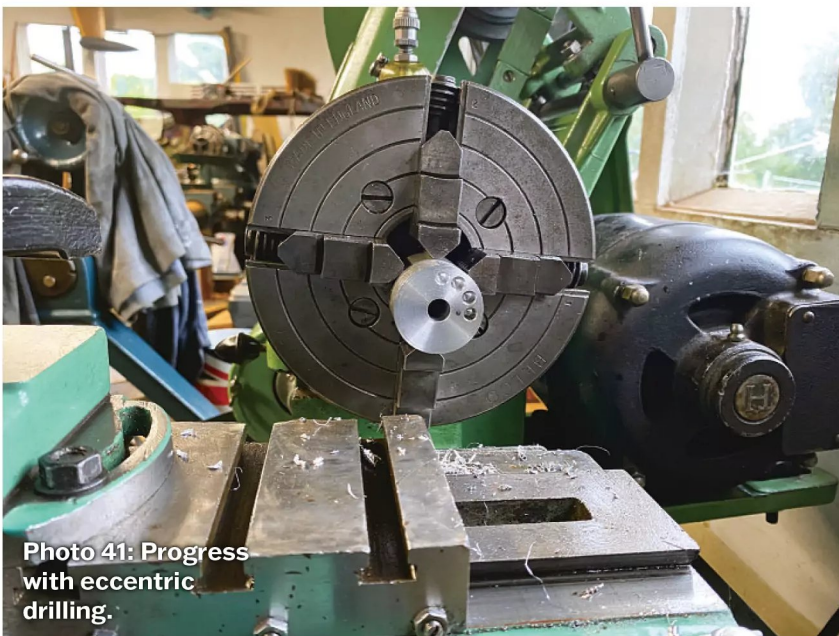


Photo 41: Progress with eccentric drilling.

Drilling eccentric bores can be accomplished in the lathe. Using either a four-jaw chuck or a faceplate the work is positioned off centre, ensuring it is safely balanced when rotated. This approach was used to make the part shown in **photo 38**. The part represents a bicycle chain ring complete with one crank that was made to experiment with eccentric drilling only. The parts shown in **photo 39** are the results of these eccentric drilling experiments. The method used to drill eccentric bores is as follows. A short length of aluminium bar was positioned in a four-jaw chuck and the desired amount of central offset was set in the x axis, photo 40. This was achieved by

loosening one jaw and tightening the opposing jaw, until the part was offset by the required distance. The remaining two jaws were brought up to meet the part with the aim of maintaining centrality in the y axis. All four jaws were finally tightened. The amount of offset was checked by placing a marker pen into the drill chuck and making contact with the work. Once satisfied with positioning, the first bore was drilled to depth using a BS4 size centre drill. The remaining eccentric bores were drilled the same way. To rotate the part, two of the jaws at 90° to each other were loosened slightly and the part was rotated to the next position. The rotation was not

measured, but set by eye, as an indexing method was not available. With hindsight, it would have been better to mark the positions of the angles required onto the face of the cylinder before beginning. The progress of drilling eccentric bores is shown in **photo 41**. The advantage of this eccentric drilling method is that a twist drill bit held in the Jacobs chuck of the tail-stock can be used to drill each bore, i.e. each bore is made in alignment with the axis of rotation of the lathe.

The disadvantage of this method is that any indexing facility that can be used to accurately set the position of the lathe spindle is of no use. This is because rotation of the part is independent of the spindle. However, in some or many instances, the ability to easily accomplish eccentric drilling will outweigh this limitation. A solution to accurately index the eccentrically mounted part would increase application of the method described here.

An alternative method to enable eccentric drilling on the lathe is to use a powered drill mounted onto the cross slide. Using a dedicated indexing or dividing tool attached to the lathe spindle, the spindle can be rotated a set number of equally spaced increments, ref. 2, 3. This facility can also be used to cut gear wheels mounted onto the spindle, but it does require another cutting method, such as using a milling attachment. Some lathe manufacturers have overcome this problem by manufacturing a dividing attachment to rotate the component independent of the lathe spindle. The attachment and the component mount onto the lathe cross slide. The lathe spindle is then free to power a cutter mounted between centres on an arbor, ref 3. Another indexing option is to use the change gear wheels that usually accompany the lathe. These can be placed onto the outboard end of the lathe spindle and with some ingenuity a locking mechanism can be made to hold the spindle in position, **ref. 3, 27**. To drill radial bores into a component, using the lathe spindle as an indexing tool the part can be marked out. Some engineers choose to mount a drill onto the lathe carriage to enable the drilling of circumferential bores, but it is often easier to remove the part once it is marked out and complete the drilling on a pillar drill.

REFERENCES

26. Micro Drilling -- Stop Breaking Small Drills !! <https://youtu.be/PqU5wSOJ4MU27>.
27. Michael Cox, Headstock indexing on the Mini Lathe, *Model Engineers' Workshop*, 344, October 2024.

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

Readers! We want to hear from you! Drop us a line sharing your advice, questions or opinions. Why not send us a picture of your latest workshop creation, or that strange tool you found in a boot sale? Email your contributions to meweditor@mortons.co.uk.

THE NEW LOOK MAGAZINE

Dear Neil, the latest copy of the new ME & W just dropped through the letterbox and, oh dear, all my worst fears were confirmed - the cover had a couple of models of 150-year-old locos, probably built to pre-war plans as used by literally generations of model engineers. My heart sank - this was the reason I stopped reading ME years ago when I found out MEW (issue 48) existed. Much more useful for a beginner in model engineering although my skills may not have kept up with my knowledge! I started to read - more loco pictures on the contents page,

this doesn't look good - but gradually I realised it wasn't bad at all. In fact it was really rather good with a nice balance between the two areas of interest. I may never have the desire to build a boiler, let alone a locomotive, but I can certainly appreciate the work that goes into them even if I do not have the patience for that sort of thing. Much to my surprise I am looking forward to the next issue, locos and all. Well done. **Paul Reeves, by email.**

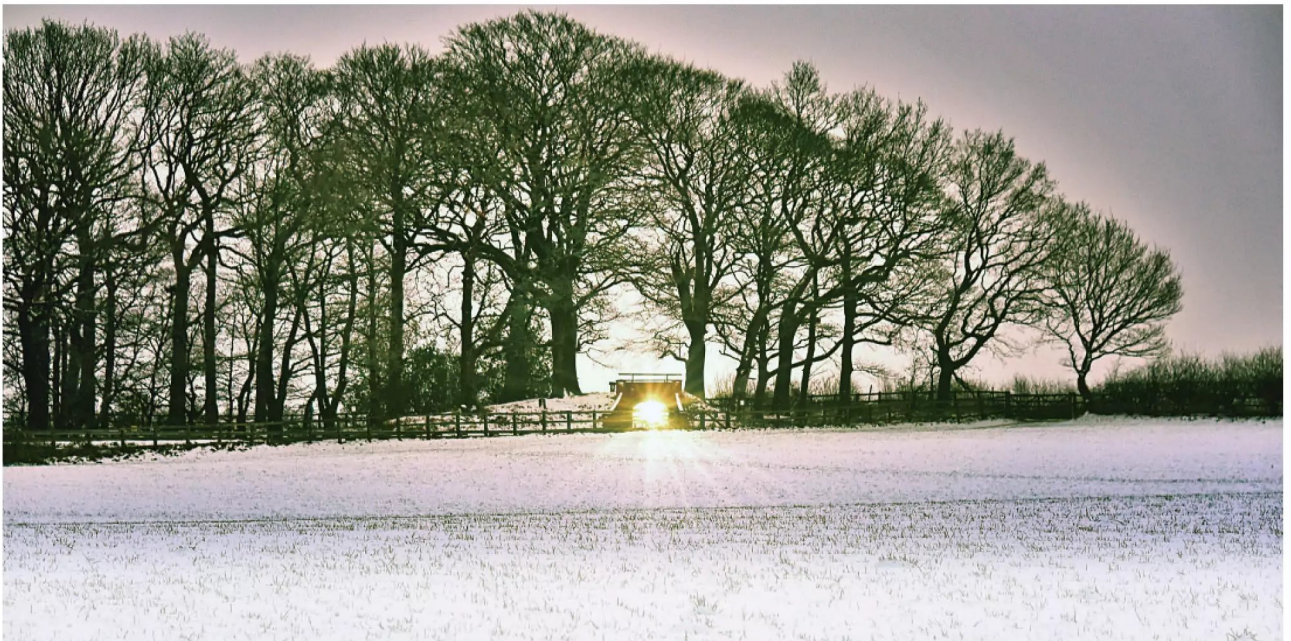
Thank you, Paul. Your letter is broadly representative of many of the messages I have received, though not all! My thanks to the

many readers who have provided encouragement and useful feedback on our previous issue, both directly to me and through the forum. Neil.

DAIRY ENGINE QUERY

I am building a dairy engine from drawings in Model Engineer magazine circa 1998/1999. The boiler bushes seem to have been omitted. I am optimistically hoping that you (or a reader) may have details for them. Any information would be greatly appreciated.

Graham Smith, by email.



SUNNY DAYS AHEAD!

Dear Neil, readers may like this photograph of sunrise through the tunnel at Warrington DMES, on 6 Jan

2025. Taken by one of our neighbours Paul Bellas. The story that the sun shines through box tunnel on Brunel's birthday is not correct, but 6 Jan is the birthday

of amongst others Joan of Arc, Mr. Bean (Rowan Atkinson), Sherlock Holmes and Sylvia Simms (of Carry On Fame) **Duncan Webster, Warrington.**

BL 12-24 SCREWCUTTING QUERY ANSWERED

Hello Neil, with regard to Peter M Hardy's question on how to cut a 1.75 mm pitch thread on his Engineers Tool Room BL12-24, (With 3 mm pitch Leadscrew, ME&W Issue 4762) there does not seem to be an exact set up.

However, if he sets the changewheels to 40 (Driver):120/127 :32 (Leadscrew) and the Gearbox to C-3 the nearest that he will get is 1.7498 mm, if my calculations are correct. This assumes that his lathe, like mine, came with an additional 32T gear. The changewheels, from memory, are 1.25

Mod, if anyone wishes to make their own. The Warco BH600, and Chester Craftsman are likely to have been produced in different factories, and to different specifications, so may not include the 32T gear.

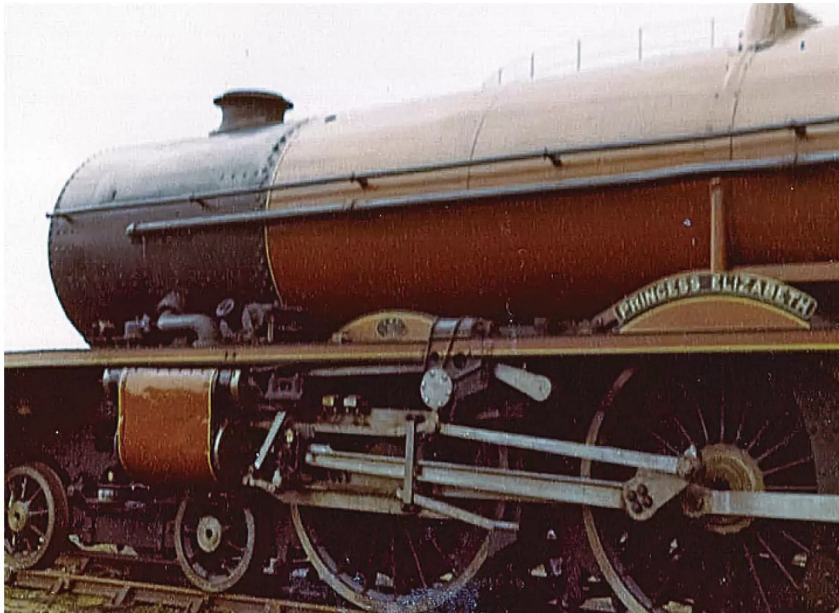
Howard Lewis, Peterborough

VALVE GEAR BACKSET

Hello Neil, Congratulations as our new editor. ME has gone through a lot of changes over the years and I am sure it will carry on although there has been a seismic shift in activities. I have some editions from 1956 and there were a lot of youngsters at exhibitions in those days.

My query is this: Why was there no backset on the outside Expansion Links of the first two LMS Princess Pacifics. See my photo of Princess Elizabeth at Hereford in April 1977. I also think that the inside Walschaert drive on the GW kings had no backset. Would anyone care to comment?

John B Coop, by email.



V-TWIN STEAM ENGINE

Dear Neil, I appreciate the May 1990 edition of ME was a long time ago, but at that time the library where I was a member, subscribed to Model Engineer who published an article on building a model Vee Twin Engine. I've kept a copy of the article since then 'just in case' and would like to build it now!

Unfortunately my copy isn't too clear, especially about the timing gears, other than that they were stock items available from Davall. A good range appears to be still available - online!

I wonder if a reader could provide any information especially the size?

Colin Haines, by email

FREED RUSTED PISTONS

Dear Neil, There is an alternative to merely forcing a stuck piston out of a cylinder when rust is involved, either rusted rings, a rusted piston, or a rusted bore. ("Unseizing a Beam Engine", ME #4758, 26 December 2024) One can use a solution of iodine in denatured alcohol. It will find its way through the rust and deal with it. I last used it on a cast iron Briggs and Stratton engine on a reel mower that had sat for decades. I removed the cylinder head and poured the solution around the top of the piston. Luckily the piston had seized in mid-stroke so that I did not have to disassemble the bottom end. After about twenty minutes a large piece of wood placed on the piston and struck with a hammer, not too fiercely, moved the piston easily. The follow-up was a goodly dose of cylinder preservation oil

worked into the piston rings by turning the engine with the starter rope. I was surprised by how rapidly the solution acted. Also, there was a mark from the piston ring around the cylinder at the position where things had stuck. The mark was attributed to a little carbon having been leached out of the cast iron cylinder. The implies that one should start to try to free the piston almost immediately after putting the solution on.

The use of an iodine and alcohol solution for dealing with seized pistons was well known when I was young (too many decades ago) but appears to have been almost forgotten.

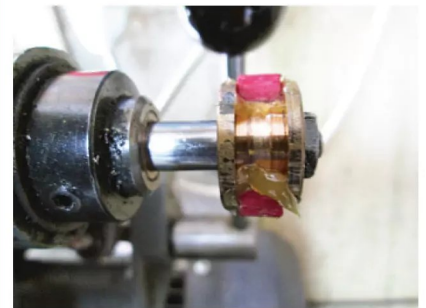
The delay in this letter bespeaks last year's postal strike in Canada. The above issue of ME only arrived yesterday.

John Bauer, Canada

MYFORD CLUTCH ODDITY

Hi Neil, looking at Laurie Leonard's article in MEW #348 on the ml7 clutch repair, I have never seen any mention of these necessary parts for a smooth operation of the clutch. There is no sign of these parts being mentioned in the pics of the clutch that I have looked at. I also found one missing on my own Myford clutch.

Geoff Warner, by email



WHEEL PROFILES

Dear Sir, I am disappointed reading all the time and seeing different dimensions for wheel profiles given by your various contributors for their 5" Gauge engines. In addition, they look to have no commonality in the gap between the inner flanges. The most annoying thing is a book by Martin Evans has covered this subject very well, and his work is proven by many more learned than myself to be correct. So I would like to refer you and all readers to his book *The Model Steam Locomotive* page 11 for the tread profile and page 53 dimension 4 11/16". To those who wish to design and build their own locos, may I suggest buying a copy of his book before you begin. Would it hurt if you wrote out a few basic rules for contributors to follow.

MJP, Louth

Thanks for your letter, which went to my predecessor. You may have opened a can of worms. There are different standards, especially for profiles, used by different clubs, and back to back distances can vary (especially between countries and standard/narrow gauge). Even in full size there are many variations in profile depending on the duties the loco is expected to perform, let alone between different historic locos. While there are standard profiles, what a designer specifies may depend on whether or not they wish to model for close scale versus more widely used standards (e.g. GL5 use a narrower overall width). Clubs with aluminium rails may also specify different profiles to minimise wear. Perhaps someone could write a brief summary of the various options? My own suggestion is that builders should consult first with the club where they expect to be running their loco. Neil.

SUGAR CANE LOCO

G'day Neil, today I was thumbing through an old issue of Model Engineer when I stumbled across mention of David Proctor. This can be found on page 51 in issue 4719 16th to 29th June 2023 in the captions to photos 55 and 56 showing a boiler feed pump and an oscillating engine.

Could this be the same bloke who edited the Australian Model Engineer magazine? If so, I wonder if he would like to tell me how he can be contacted nowadays. I've been trying to locate some instalments concerning the building of a Queensland sugar cane narrow gauge loco that I'd missed while ill. The project was published in AME about 6 years ago. I'd been a regular reader of and occasional contributor to AME, providing some rotary table and dividing head spreadsheet calculators, etc. However, soon after Dave announced that AME would cease publication, I found that his email address had turned into a magic pumpkin and I've never been able to obtain copies of the missing instalments.

Ron, Australia

Can a reader point Ron towards the missing instalments for this loco? Neil.

SURFACE GRINDING IN THE LATHE

Dear Neil, Neil Raine mentions various dedicated attachments for the Lathe to enable precision milling in his series on Drilling and Boring (ME issue 4759). He states that with the vertical milling slide and surface grinding is a possibility, and that there are attachments for external cylindrical grinding and internal grinding on a Lathe.

Having been a Toolroom Grinder with experience on Surface, Cylindrical, Tool and Cutter, Optical Profile and an ODD for a Toolroom Centreless Grinding, I'm intrigued how one would do Surface grinding on a Lathe,

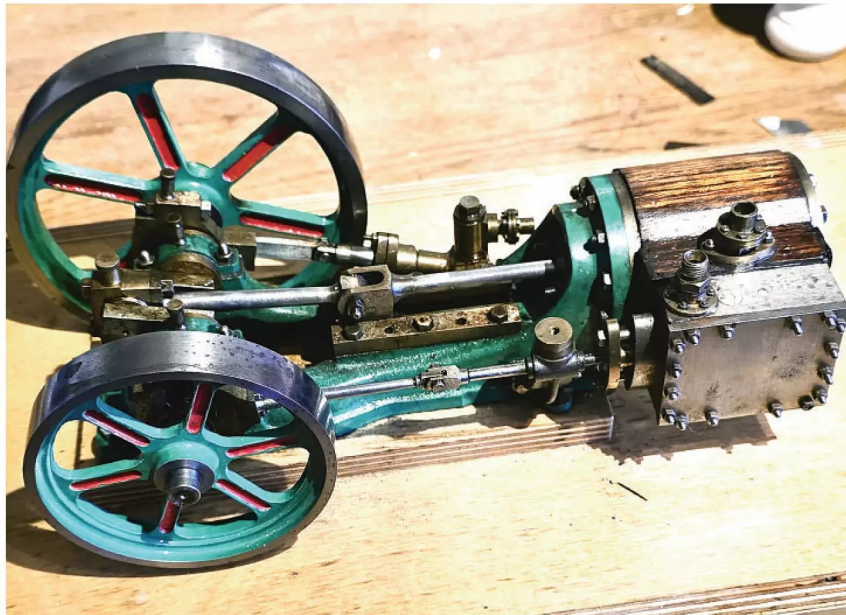
Len Cook, Burton upon Trent.

WORKSHOP LAYOUT TIPS

Dear Neil, I recently received MEW issue 346 here in NZ, snail mail takes a bit of time!

May I add a few tips on the issue of workshop layout. Having moved multiple times, including four times internationally, I am familiar with the challenges. My workshop currently is in a double garage in a new-built house seven years ago, so I had the chance to plan reasonably well. My tips are as follows:

If building from new, do not line the workshop with plasterboard. Use



MYSTERY ENGINE

Good morning Neil, I'm very sorry to bother you with this but I have no idea where else to go. I have been left the machine pictured here by a friend's father and have no idea what make it is or where I could sell it. I want it to go to someone who will appreciate it. Can you please help?

Julian Moxon, Crickadarn, Wales

Can anyone identify Julian's engine? Neil.

plywood instead. It is a lot easier to attach "stuff" to it.

As I have motorised doors, I have put a double adaptor at the overhead plug, and then put in a dropper extension plug, hanging down to shoulder height. This helps eliminate trailing cords on the floor which are a trip hazard and dust collector.

When designing a layout for my machines, I made a grid map of the future workshop, and then made cutouts of each machine. These cutouts included a clear coloured plastic cutout surrounding the machine, denoting the working space around that machine. The advantage of this is that the working spaces can overlap, but the machines obviously cannot.

Regarding file storage. I wrap my files in aluminium foil. To my mind, this has two functions. Firstly, it prevents them rubbing against each other, so preventing damage and loss of sharpness. Secondly, the foil acts as a sacrificial anode, so preventing rust forming.

Storage of small parts. I envy those who have lots of tin boxes. My solution is to use clear plastic bottles (not glass!). My bottles are in drawers and have white lids, labelled using a black marker. I also use flat plastic compartmentalised fishing boxes for small components.

If you are needing a surface plate, I

scrounged a nice piece of granite which was being removed from our building at the time to make way for renovations. Maybe a kitchen top company could be asked for a basin cutout.

Circular LED lights are available from China for selfie picture use. I have two, mounted on my mill and drill press.

They are very reasonably priced.

I hope the above helps readers.

Chris Pattison, Tauranga, New Zealand

ONLINE INDEXES

David Frith's has kindly agreed to prepare the indexes for Model Engineer & Workshop which can be downloaded from the Forum at www.model-engineer.co.uk – just select Forums and then the Model Engineers' Workshop topic. Alternatively scan the adjacent QR code.

If you prefer the paper indexes, don't worry, David will be producing these in the future as well.



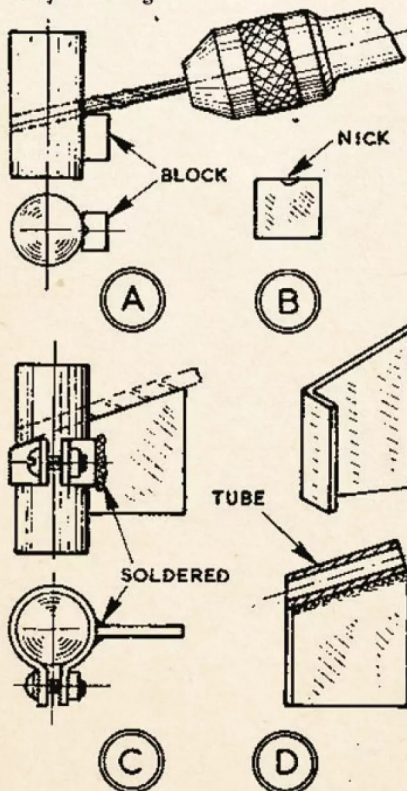
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that may be out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practised in the past.

Oblique drilling

WHEN SOME EXPERIENCE in drilling and sharpening drills has been acquired, ordinary work with normal-size drills presents little difficulty. If a machine drill is available, work can be mounted on the table, in vee blocks, or in the machine vice. In drilling by hand care is essential, of course, to avoid breakage if the drill is small; and it is necessary to maintain reasonable squareness if the material is thick—which can usually be done by “sighting” the drill against the surface.

There are occasions, however, when it is necessary to drill obliquely or out-of-square—and difficulties may then be met, first in starting the drill on the sloping surface and, secondly, in guiding it at the required angle.

Various methods of guiding a drill for oblique drilling



To the first problem—starting the drill—there are several solutions. A fairly large and deep centre-punch dot can be made and the drill in a hand machine may then be started either squarely or at a lesser angle than that required. When the full diameter of the drill is below the surface on the low side the drill, with no forward or in-feed, can be gradually brought round to the angle. Alternatively, a larger and shallow hole can be drilled squarely—and the required hole started in the bottom of it at an angle.

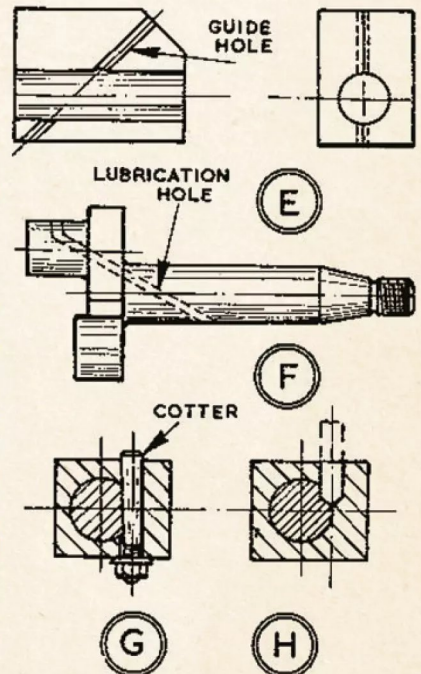
Again, two holes of the required size can be started squarely and close together for a little distance, with the drill brought round at the required angle. In some instances a short rotary file or mill can be presented to the surface at an angle to provide a surface on which the drill can be started; and on occasion such a surface can be filed or chiselled. At times, too, it is possible—or even desirable—to employ a simple jig as described. In most instances, with the hole started, the work can be completed by hand or transferred to a machine drill and carefully set up.

A drill, of course, slides off a sloping surface because it is unsupported on one side and a simple method of preventing this is to clamp a small block of the same material for the point to be retained at the required position, A. Such a block can be used on both flat and round material and provided with a shallow filed nick, B.

When the opposite side of the material is also sloping, care and a fine feed are essential when the drill is breaking through—otherwise breakage may occur; and in this connection it is helpful to clamp a small block over the position where the drill point will appear.

Angle guides

The second problem—guiding the drill at the required angle—can usually be overcome fairly easily. It may be enough to make an angle gauge from thin cardboard or sheet metal and hold it against the surface to get the line for the drill. The angle for the gauge can be marked with protractor and pencil on cardboard or with a scribe on metal.



Jigs for drilling round components

For a fix-on gauge for round stock, C, a simple clip is first produced, followed by the angle gauge which is held and soldered in place. Such a gauge can be fitted after the hole has been started to maintain the line while drilling. For flat stock the gauge can have the fixing edge turned at right angles for a clamp, D, and with both types a piece of tube can be soldered to the angled edge to guide the drill if required.

The best type of jig for round components of moderate size, both to make and for occasional use, is the halved or split type, E. To make it two blocks of metal are drilled down the joint line. Then using a protractor the line for the drill is scribed on each face, each line being deepened with a three-cornered file. Following this the blocks are reclamped and the vee-grooves drilled circular. This jig can be used for the big-end lubrication hole from the mainshaft of a small crankshaft, F.

Angle drilling of another variety is to cotter-secure a shaft, G. Without support it would be impossible to drill the cotter hole. But if the bore is plugged with tight-fitting material of the same sort, the hole can be easily drilled and reamed, H. □



How, Not, to Build a Locomotive... for Someone Else

Jim Woods and Jonathan Bregazzi conclude the story of their two 2-4-0 Beyer Peacock tank locomotives with details of the completion of Loch.

The water tanks, cab and bunker are all 0.8mm brass (**photo 12**). I cheated here. I had created CAD files for my own engine years ago and had them laser cut. There are about 3000 plus 5/64 inch rivets all up - 'pimples everywhere', as LBSC would say - and I didn't relish drilling them all and trying to keep fairly straight lines. I made several bending jigs to do the corners. This was done in an hydraulic press with formers and jigs, **photo 13**. Inside the tanks is a framework of 1/4 x 1/4 brass angle. I machined my own angle out of 3/8 inch brass bar. The corner angle frame parts were NC machined. All this is both riveted with the 5/64 inch copper rivets and sealed using solder paste used for printed circuit boards. Great stuff. I painted it on with a brush or used a syringe on the angle surfaces before riveting and gently heated the areas

with a plumber's lead welding acetylene/air torch. It flowed beautifully just where I needed it. Cleaning up was easy with warm soapy water. No leaks were found on the first test filling of the tanks. The tank bottoms are screwed in place with 2mm brass countersunk screws out of sight. All the rivets are closed up with various snaps and long reach closers that went in an arbor press I made during my apprentice days (**photo 14** - at last, I had found a good use for it after 40 years!) The gentle curves on the cab were done using a copy of the George Thomas rollers another fellow club member and friend had just finished, **photo 15**. Russell is a fine model engineer and makes some truly wonderful objects. The sheet brass only just fitted across the rollers. The window frames are CNC machined in brass. They are screwed together with

1mm countersunk screws. The glass is microscope slip glass. The hinges are on 0.8mm TIG stainless steel welding wire. The running plates are in 1mm Zintec mild steel, again laser cut at our local sheet metal company here in Dunedin. The buffer beams are made of oak. I managed to get a leaf out of an old English oak table from which to cut out the beams. The floor in the cab is a New Zealand native timber called Pohutukawa - the New Zealand Christmas tree (because it has a red flower that comes out over the Christmas period). The wood is from a branch of a tree in our garden that had seasoned well for quite a few years. I heat treated it in the microwave and it was sawn up in the mill into planks, then glued and 'nailed' to a steel backing with dress maker's sequin pins to resemble screws. The Manx Peacocks have wind cheaters

PART 2



or 'dodgers', made from canvas on the cab sides. Normally old ships' sail canvas from way back was used. Here I enlisted the help of my wife who is a dab hand in the sewing department. I found some suitable coloured linen fabric. They are in the rolled-up style on the cab roof that became commonplace in the later and post Ailsa days.

PAINTING

Painting the locomotive was a trial in itself. Jonathan was most insistent on the colour he wanted, which you read about earlier. Fair enough too; he was paying for it. It had to be a certain shade of green. After much discussion back and forth over 12,000 miles, Jonathan settled on Kawasaki green that I got made up here. Now I hate painting and hate the colour green. (It's considered



Photo 11:
Mike Casey's
loco jack.



Photo 13: Press tooling
for the tank ends.



Photo 12: Rolling
the cab sheets.

bad luck in our family!) I did buy Chris Vine's book, *How (Not) to Paint a Locomotive* as I wanted a good finish on No. 4. It is a great book with lots of helpful tips but I had the devil's own job with dust and lumps, so I built a spray booth out of my CNC mill enclosure, **photo 16**. The poor mill had been sidelined for a while as the controller was zapped after a thunderstorm and we had a lightning strike. I lined the inside of the enclosure with clear plastic cover sheets and created a tent top. I also fitted an extraction fan and filters. This helped heaps, but towards the end the lumps got worse. The paint had gone bad. Endless filtering and flattening back with ultra fine sandpaper after each coat were just enough to finish painting to a near enough finish. Chris was of immense help during this period. There are three main colours in the locomotive; Satin Ailsa (Kawasaki) Green, Satin Black and Signal Red. I was going to line-out No. 4 by hand as shown

in Chris Vines book but, unless I had a few wee drams, I could not get to do the corners well enough on my practice pieces, so I had a professional sign-writer create decals and coat of arms to CAD and/or scanned drawings, **photo 17**. Once these were applied, I sealed everything with a clear coat. The nameplates, numerals on the chimney, and the Beyer Peacock on the sector plate behind the regulator handle are by a certain Diane Carney! She turns out some beautiful work. I did engrave the OPEN and SHUT on the sector plate in the NC mill. Now, there's a little story about both engines' nameplates; both Nos. 4 and 5 have a space between the second and third letters of their single word name, No. 4 is LO CH and No. 5 is MO NA. It seems that at the time the orders for the engines were placed with Beyer Peacock, the Isle of Man Railway wanted the nameplates in the centre of the tanks. The injector overflow, however,



Photo 14:
Riveting with
the arbor
press.



Photo 15: Forming the
tighter cab sheet radius.



Photo 16:
Makeshift
spray booth.



Photo 18: 3rd
March 2024.

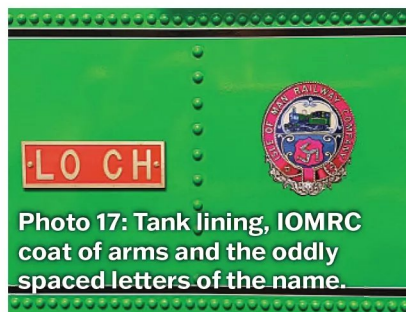


Photo 17: Tank lining, IOMRC
coat of arms and the oddly
spaced letters of the name.

ran down the outside of the tanks but then partly covered the nameplates. Beyer Peacock simply made the patterns to allow space between the letters so that the name looks correct with the pipe in the way. Nos. 1, 2 and 3 and subsequent locomotives had their nameplates fitted forward on the tanks (presumably to avoid the overflow pipe). Nos. 10 to 13, however, had the overflow pipe running down through the tanks so the names on those four could be centred. Funny that.

COMMISSIONING

Commissioning started in mid-March 2024, **photo 18**, once the boiler had passed its 2x hydraulic test and steam tests as per the current AMBSC code. A week later Jonathan arrived in NZ. We had a trial steam up at home, **photo 19**, up on blocks, and two days later the first track trials showed the engine had promise to be a good performer. As with all new locomotives, a few little niggles appeared and have

been rectified.

My No. 5 has a stone I picked up from the top of Snaefell, the highest point on the island, in the bunker and No. 4 has a piece of Otago Peninsular Rock in hers (*awwww, that's nice* - Asst Ed.).

Shipping was, for me, the last act in the play. In 2000, when No. 5 came on holiday for IMLEC, she was put in a box and shipped over without any real hassles. Now, in 2024, the box and pallet have to be made of plywood/MDF and/or special high temperature treated wood for export. Luckily for us there is a place here in Dunedin that sells this. How times have changed...

That about sums it all up really. Here's one final photograph of the twins together, **photo 20**. I do hope the wait was worth it and I wish Jonathan all the best with little *Loch*. Who knows, he might let me enter IMLEC next year or the year after with her.

Many thanks to all my model engineering colleagues for help and guidance, but mostly to my wife, without whom I would have starved. 🍷

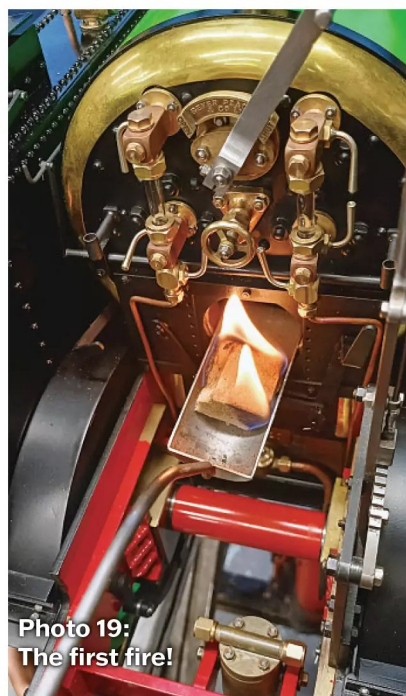


Photo 19:
The first fire!



Photo 20: The twins together for one last time before
little *Loch*'s departure to its new home. (Photo by Lachlan Clark.)

Extracting a Broken Stud

Alan Donovan makes a jig to aid the precise drilling out of a seized bolt.

Photo 1: The fractured bolt end stuck in the manifold thread.

I am currently refurbishing an old electricity generator, driven by an Aspera engine, which should, hopefully, be finished by the time you read this. The age of the generator unit is unknown, but it is in fair condition despite needing some refurbishment and tender loving care.

The exhaust muffler and fasteners were highly corroded and required replacement. When removing the bolts, one bolt sheared off leaving the threaded portion stuck in the exhaust flange, **photo 1**, not an unusual workshop problem. Corrosion of this bolt was particularly severe, as the threaded hole was on the outside of the engine and exposed to the elements, unlike the remaining three holes. I was worried that the use of a stud extractor would fail – it could fracture in place, making the problem worse. I decided to drill out the remaining bolt core, such that the original manifold thread would hopefully be left intact.

The bolts are believed to be 0.250" UNC – this is based on the Aspera engine being a Tecumseh (USA) engine manufactured under licence by Aspera in Italy, and the remaining manifold threads readily accepting a 0.250" UNC bolt. Drilling out the bolt core with the required accuracy to leave the female manifold thread intact would not be easy, so I decided a drill jig was required.

JIG DESIGN AND USE

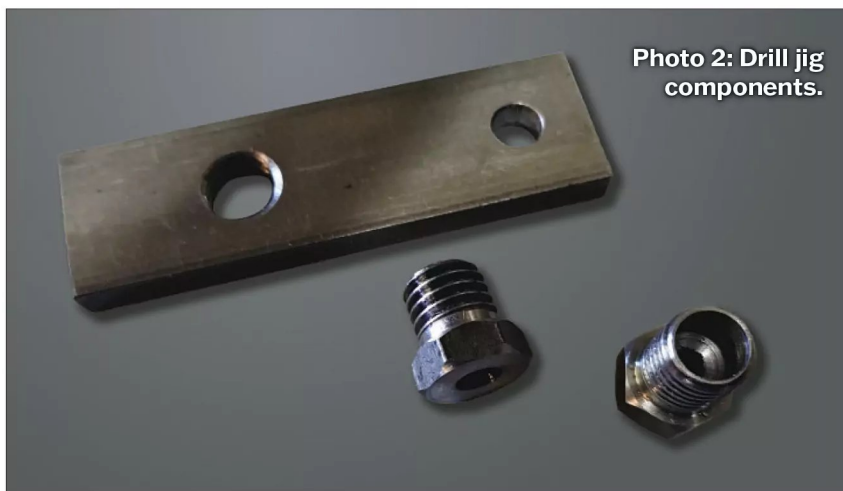
The jig design was to take the form of a simple plate that could be bolted to the manifold. One end would have a 0.250" diameter hole through, this is nominally zero tolerance on the diameter of the securing bolt that would secure the jig to the manifold. The second hole, pitched at the exact dimension for the manifold bolt centres, would be threaded such that it could accept a guide bush for the drill, M10 in this case. Two bushes were made; the first to guide a smaller drill to generate a pilot hole down the centre of the remaining length of bolt and the second

bush to guide a drill that matches the core diameter of the UNC bolt, 5.3mm diameter, and follow the previously generated pilot hole.

Mild steel was used for all components, **photo 2**.

As the fractured bolt was proud of the manifold face, the drill guide bushes were to be counter-drilled on the inner face to match the outside diameter of the bolt thread. This ensured the bush encapsulated the remaining bolt and ensured concentric alignment of both items. The depth of the counterbore would be extended to allow for the collection of drilling swarf. Both bushes would be externally threaded M10 to

Photo 2: Drill jig components.



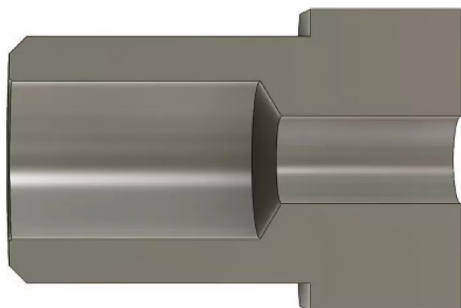


Figure 1: Sectional view through a drill guide bush.

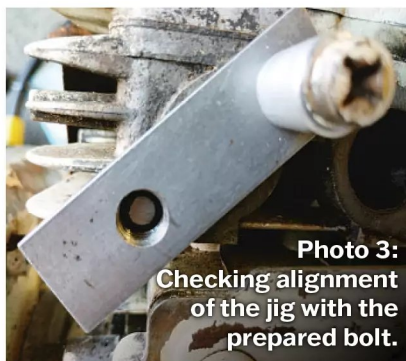


Photo 3: Checking alignment of the jig with the prepared bolt.



Photo 4: Installed jig plate – ready for drilling pilot hole.



Photo 5: Inspection of the guide hole after the first drilling.



Photo 6: Picture of finished repair.

allow them to be screwed into the jig plate. It was anticipated that the bush bores could wear while the drilling operations were being undertaken, so both bushes were case hardened to resist damage. For a sectional view of a typical drill guide bush see **fig. 1**.

Correct setting up of the drill jig is important to ensure the best chance of success, as was correct preparation of the bolt. The exposed end of the fractured bolt was filed flat to minimise the risk of the drill drifting off centre. The manifold face was cleaned, the mounting plate was firmly bolted to the manifold and the guide bush hole centred around the fractured bolt, **photo 3**. The drill guide bush (for the pilot hole) was screwed into the jig plate and checked to confirm it encapsulated the fractured bolt correctly. I was now ready to start drilling, **photo 4**.

Drilling commenced using a 3.5mm drill until I had drilled right through the bolt. This was quite difficult due to the high tensile bolt material, so

Rocol RTD metal cutting compound was used to lubricate the drill during cutting. The bush was removed and replaced at least twice to clear swarf. I was very pleased with the first drilling as the guide hole appeared to be 'dead centre', **photo 5**. This was exactly what I had hoped for.

The jig was reinstalled, but this time with the second drill bush. Drilling was undertaken with a 5.3mm diameter drill (this is the tapping drill size for 0.250" UNC female thread). The jig was removed and the hole inspected. The hole was reasonably clean, but the old bolt's thread helix remained and could not be eased out. The first turn of the manifold thread was clear, so I decided to clear the bolt's thread helix using a 0.250" UNC tap I had found. It was rather worn, but I deemed it acceptable for this task. Rocol RTD compound was used on the tap. Carefully engaging the tap with the lead on the thread, I was able to remove the old thread helix. The manifold thread looked rough on the

surface. This is probably a by-product of the corrosion but, in my opinion, it is adequate for its intended task.

Photograph 6 shows the final result.

Since undertaking this repair, I have purchased a new muffler together with gasket and bolts and everything assembles as intended and is secure.

LESSONS LEARNED

If the thread revival process had failed my 'fall back' plan was to drill out the hole and fit an M6 'Helicoil' thread insert with an M6 bolt, but I wished to retain the engine's originality.

With respect to the drill guide bushes I would, with hindsight, manufacture an intermediated bush with a 4.5mm diameter bore and then followed with the third bush of 5.3mm diameter. I feel I may have ended up with a cleaner thread had I followed this route. The case hardening was 'enough' to preserve the life and accuracy of the bushes for this single task. ●

Newton Tesla (Electric Drives) Ltd have been trading since 1987 supplying high power variable speed drives and electric motors to industry up to 500KW so you can be confident in buying from a well established and competent variable speed drive specialist.



New product promotion, AV550 550W motor / inverter for the Myford Super 7. Call for details!

Managing director George Newton, originally from the British Steel industry where he worked with 20,000 HP rolling mill drives is also a skilled machinist and uses his own lathes to design and refine speed controllers especially for the Myford ML7 & Super 7

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On the Wire

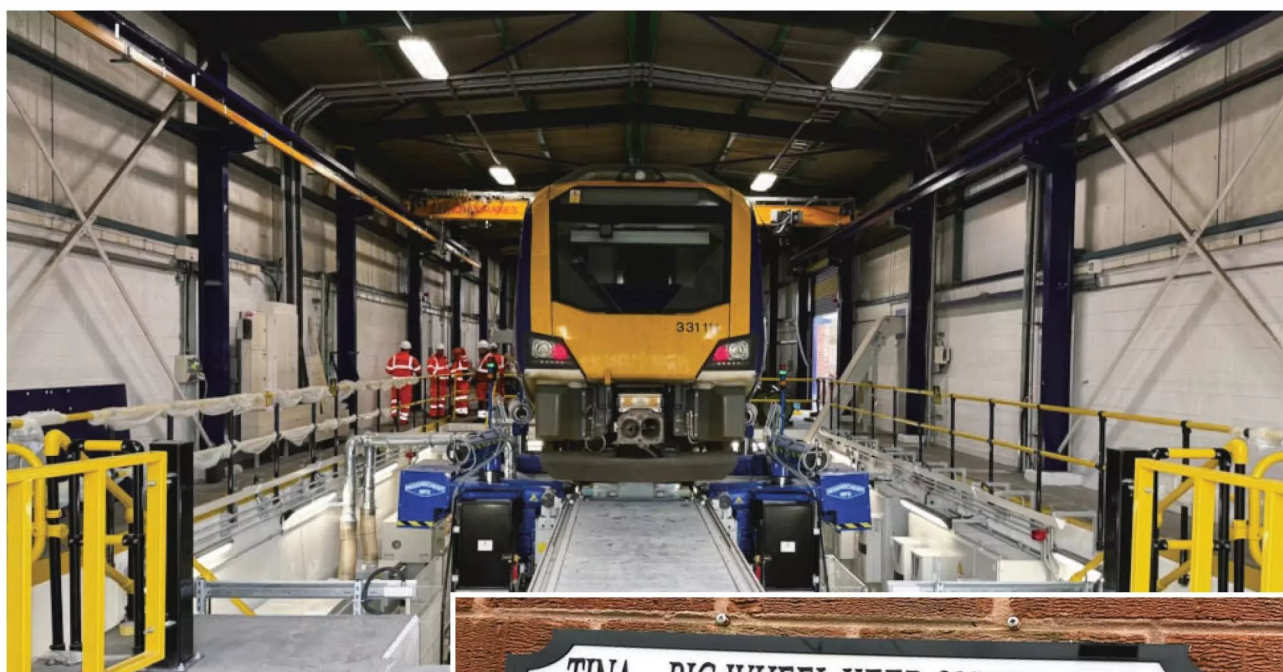
News from the world of engineering

A NEW WHEEL LATHE FOR NORTHERN TRAINS

A wheel lathe named Tina has been unveiled as the latest weapon in the battle to ensure the region's train wheels "keep on turning". The machine, which reshapes and balances a train's wheels following natural wear and tear in service, reduces the impact of the train on the track and makes journeys smoother for customers. It has been installed at Allerton TrainCare Centre in Merseyside as part of an £8.9m project between

Network Rail and Northern. Nicknamed 'Tina' by the train operator's engineers, she replaces an old wheel lathe called 'Charlotte' and has doubled the wheel-lathing capacity of the depot. In total, 1,600 tonnes of soil, stone and concrete were excavated to accommodate her and 184 tonnes of concrete was used to set the lathe in place. Jack Commandeur, engineering director at Northern, said: "Tina is a

very much welcomed addition to the engineering arsenal and will enable us to repair wheels without having to remove them from the train, which makes the process far more efficient. "Turning wheels on the lathe extends their life and reduces the costs associated with replacing them. The increase in wheel lathing capacity also means trains will spend less time out of passenger service for maintenance."



SPRUNG PARTING OFF TOOL

We have had some feedback on missing dimensions in the drawing for Bruce Porteous' spring parting off tool (ME&W issue 4962). We reproduced the drawing as supplied, and while these dimensions would help in making an identical item, it was the author's intention that readers would adapt the design to suit their own lathe. The drawing was reproduced slightly larger than full size, and as none of the dimensions are critical measuring from the drawing and multiplying by 0.925 and taking the nearest convenient figure should be more than adequate. This gives the overall size of the block as 50 x 75mm, for example.



A SWISS METAL CONSTRUCTION KIT EXHIBITION

Many readers will have fond memories of constructional toys like Meccano; some may even be old enough to remember Juneero? Henk-Jan de Ruiter has sent this flyer from the Amateurs für Metallmodellbau in der Schweiz for an exhibition of models from 'the world of metal construction kits'. The exhibition takes place in Lucerne (Luzern), Switzerland on the 5 and 6 of April.

BLUE GHOST LANDS SUCCESSFULLY ON THE MOON



We don't normally carry on a story from a previous issue, however we feel that a successful moon landing is worthy of mention. Carrying a suite of NASA science and technology, Firefly Aerospace's Blue Ghost Mission 1 successfully landed at 3:34 a.m. EST on Sunday near a volcanic feature called Mons

Latreille within Mare Crisium, a more than 300-mile-wide basin located in the northeast quadrant of the Moon's near side.

The Blue Ghost lander is in an upright and stable configuration, and the successful Moon delivery is part of NASA's CLPS (Commercial Lunar

Payload Services) initiative and Artemis campaign. This is the first CLPS delivery for Firefly, and their first Moon landing. The 10 NASA science and technology instruments aboard the lander will operate on the lunar surface for approximately one lunar day, or about 14 Earth days.

KELSEY MEDIA ACQUIRES MORTONS MEDIA – EXPANDING & STRENGTHENING ITS POSITION & CAPABILITIES IN KEY MARKETS

Unrelated to, but no doubt equally of note to readers, the overall ownership of Mortons Media Group has changed. This is not expected to have any immediate impact on Model Engineer & Workshop and the same team will continue to manage everything from production through to customer service. Here is the announcement in full:

Kelsey Media, one of the leading independently owned media businesses in the UK, is pleased to announce the acquisition of the Mortons Media Group Limited and group of companies. This strategic acquisition marks an exciting new era for Kelsey Media as it seeks to innovate and grow, enhancing its product portfolio, expanding its market presence, and creating significant growth opportunities. Kelsey Media has invested significantly in growth over the last 5 years and now

publishes over 80 brands in 15 markets across digital, print and events, creating value for our partners and serving our customers passions, interests and hobbies in the UK and overseas. Based in Horncastle Lincolnshire, Mortons Media is a leading specialist publishing company with strength in a number of magazine and book publishing sectors including motorcycles, modelling, rail and gardening and also benefits from a profitable and dynamic events division.

"This is a significant step in our growth strategy as we look to build market share and skills in specific markets. I look forward to working with the talented Mortons team in the coming months to further develop our products and services" said Steve Wright, Executive Chairman of Kelsey Media. Ian Fisher, Executive Chairman of Mortons Media said "In recognising

both the opportunities and longer-term challenges presented by the markets we seek to serve, I am confident Kelsey will be a great home for our brands. With the greater scale afforded by the acquisition and the combined strengths of the respective businesses and staff, I look forward to seeing them continuing to flourish in the future".

Philip Sharpe, Non-Executive Director and Shareholder of Mortons added he was "Pleased that the merged operations would be maintaining a significant presence at the Morton Way premises in Horncastle in conjunction with Kelsey's offices in Yalding, Kent". The purchase is anticipated to complete by the 25th March and includes the publishing and events divisions, with Mortons printing and distribution operations being retained by the former owners as Mortons Print and Mailing Limited.

The Stationary Steam Engine

PART 67 The Evidence, continued

As noted above, an identical drawing was used by Francis Trevithick as his Plate 5, in the *Life*, Vol. I, facing page 185. There can be little doubt about the fact that the lithographed engraving by the London engraver Kell Brothers is taken directly from the A well-executed perspective view (by modern drafting nomenclature the drawing is made up of elevations, sections and plan views rather than an orthogonal perspective) and has been annotated for a key description. Francis Trevithick must have been aware that this drawing was one of three as he lists all of them in quoting the *Gateshead Observer* article. He does not discuss the other two drawings anywhere else in his tome.

These latter two drawings are quite different from the wash drawing in character, being ink line drawings with what appears to be contemporary script. Using the Science Museum's identification Sc.M.1873-3.2 is an elevation entitled *Scale One Inch to a foot. Drawing of Wagon Engine, 3rd Oct 1804 and the other, Sc.M. 1873-28, carries the heading Regulating and Throttle cocks for Engine No. 1 (?) Sept. 17 1804. Scale Half Size*. Despite the differences the three drawings had evidently been regarded as part of a single portfolio since 1858, and this apparently continued to be the assumption made by the Naylor and Bass notice. Whether they in fact originate from a single source is at present unconfirmed.

Naylor and Bass expand upon the descent of the drawings saying that they were originally in the possession of William Tomlinson, the patter-maker at Whinfield's foundry. Tomlinson initially offered them to Robert Wylie, an iron-founder established in the Close, Newcastle. Wylie declined the offer, and they subsequently came into the possession of Thomas Smith who was manager of John Abbot & Company's Park Iron Works, located in the Salt Meadows, Gateshead, on the east side of the south landing from the High-Level Bridge. Thomas Smith loaned the drawings to Francis Trevithick when the latter was preparing his biography which can be assumed to have been prior to the publication date of April 1872 and Smith subsequently presented them to the Patent Office Museum where they were accessioned in 1873, **ref. 381**. Francis Trevithick, with his talent for sowing confusion, gives the impression that his engraving has an entirely different source although he is not specific in establishing a direct attribution. On the page previous to the illustration that forms his Plate V. Trevithick

reproduces the following two letters written to him by Joseph Armstrong, who was Locomotive and Carriage and Wagon Superintendent at Swindon following the retirement of Daniel Gooch in 1864:

Letter 1.

*Locomotive and Carriage Department,
Engineer's Office, Swindon,
19th April 1870.*

My Dear Sir,

I am in receipt of your letter as to the engine sent to Wilam in 1804 and have, as your son informed you [ref. 382], a drawing of it from which I will have a tracing made and sent to you. I got this drawing made from a tracing which was lent to me by one of my brothers, who resides in Sunderland and I understood from him that the engine itself was in existence up to a few years ago and that it was driving a fan at a foundry either in Newcastle or Gateshead; but in order that I may be able to give you more accurate information I will endeavour to get particulars of the engine, dates &c., and will then write to you again.

I am my dear Sir,

Yours truly,

Joseph Armstrong.

Letter 2.

Sunderland, May 10th 1870.

Dear Sir,

By this post I have forwarded a tracing of the old locomotive for Mr. Trevithick and likewise some copies of an extract from the 'Gateshead Observer'. They would have been sent ere now, but I have had some difficulty in procuring an original from which to get a tracing and have also spent time in hunting up this extract and having it reprinted.

Yours truly,

John Armstrong

Per: John Heming.

(Both letters reproduced in Francis Trevithick....*Life* ...p. 184.)

The situation is clarified by Robert Young, **ref. 383**, who had access to the papers of John Wesley Hackworth, son of Timothy Hackworth. John W. Hackworth had published his version of events relating to the drawings and the following is reproduced by Young:

Steel's plans became the property of Mr.

Ron Fitzgerald tells the story of the development of the stationary steam engine, this issue evidence of the background to the first Newcastle locomotive.

Smith (of the Gateshead Ironworks, alluded to in the extract from the Gateshead Observer), who had them lithographed and kindly presented me (John W. Hackworth) with a set. A set with all the above information was gathered up by John Armstrong, Timber Merchant, Sunderland and sent to his brother Joseph, Locomotive Superintendent, Great Western Railway, Swindon, who handed them over to his particular friend, Francis Trevithick, accompanied by a letter from each of the brothers Armstrong which together with these illustrations and a selection from the above-named sources were inserted in the 'Life'. I knew Messrs. Armstrong well and was very intimate with Mr. Joseph. Neither they nor the author's son, Francis Trevithick, knew of the existence of Steel's locomotive before the above evidence was elicited in print. These facts I can speak of without fear of gainsaying.

Young's own footnote to the above quotation states:

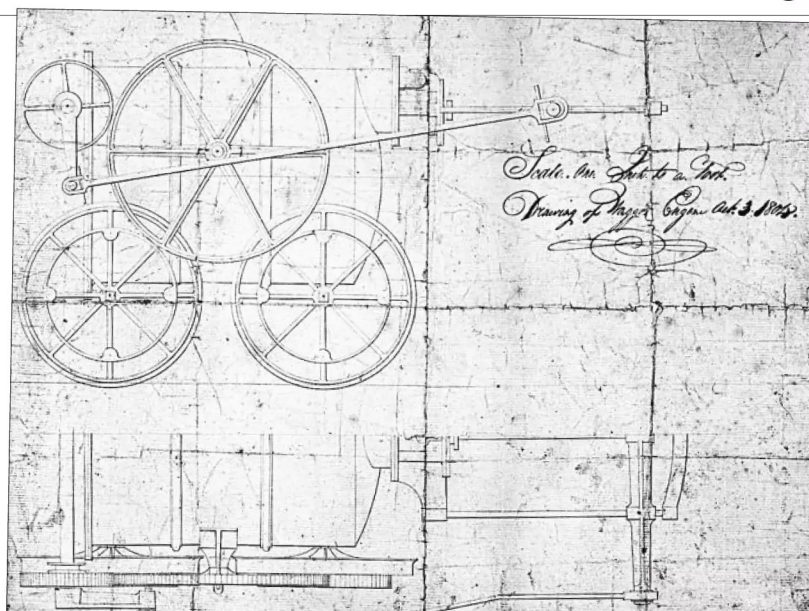
This was published by John Hackworth many years ago and this statement was never "gainsaid".

Curiously, Hackworth's letter referred to lithographed copies of the drawings whereas Joseph Armstrong speaks only of tracings. None of the three surviving drawings is a lithograph.

POSTSCRIPT

It is always gratifying to know that at least some readers are enjoying this series. Alan Cox has written twice to Postbag, the first time in September, issue 4751 and again in November, issue 4757. Belatedly, I take this opportunity to thank him for his kind comments and to reply to his queries. In his earlier letter he asks about the type of valve that was used with the gab valve gear. The ferry boat engines employed the mushroom-headed poppet valve with conical seating which Alan will see illustrated several times in my discussion of Watt's engines and also in the double valve form as part of the Murray episodes. The locomotive valves were slide valves which were virtually universal in railway practice after 1819. With regard to Alan's second letter published in issue No. 4757 November to December. The Grand Master Historian, Arnold Toynbee coined the phrase ...*The Fertile Error*... as the motor of history. Toynbee's point was that

Fig. 211. Line diagram of the first Wylam locomotive. Science Museum Group Collection 1873-3.2 1873-3/2



errors stimulate questions and questions are the essence of the dialectic that moves history forward. No piece of historical writing should ever be regarded as definitive. The subject can only thrive by virtue of debate.

Putting aside that *petit morceau* of historiography, Alan makes some relevant points. Firstly, as I think readers will now be aware, I remain to be convinced that the Coalbrookdale locomotive ever existed. The arguments have almost invariably been tendentious, and my impression is that wishful thinking on the part of the Ironbridge people has played a major role. I have not been able to find an acceptable account of how the research was carried out to substantiate the integrity of the Coalbrookdale replica built by the apprentices at GKN Sankey in 1980. The principal assumption seems to have been that the Llewellyn drawing formed an adequate basis for construction but the case seems to me to be very tenuous and rests almost entirely upon the estimated gauge of the locomotive shown in the drawing **ref 384**.

Alan refers to the Hazledine engine displayed in the East Hall of the Science Museum. By the time that the Hazledine engine is presumed to have been built the design characteristics of the Trevithick engine had stabilised and the Hazledine engine shows no departure from the "standard" with the usual vertical disposition of the cylinder and the arrangement of the fire hole, flue and manhole cover. The boiler is 4' 6" long and 3' 9" in diameter, larger than the Llewellyn boiler but smaller than either the Pen-y-darren locomotive or the Newcastle locomotive. The re-positioning of the cylinder details, as used in the earliest locomotives, is discussed in my next article.

With respect to internally flanged boiler joints, this feature was by no means uncommon, I will refer to the Middleton Railway locomotive and Woolf's sectional boiler, both of which use this type of joint.

I think the issue could be easily resolved were the Science Museum to abandon its, in my view, inappropriate museum curatorial attitude towards its exhibits in favour of a more practical forensic engineering approach. The most obvious first step would be to determine whether the seam in the Hazledine engine boiler is a gasket, be it lead or leather. A simple, very minor surface scratch would resolve the matter. If it is indeed a jointing medium, then it follows that there is a joint and that the flange can only be internal.

To be continued.

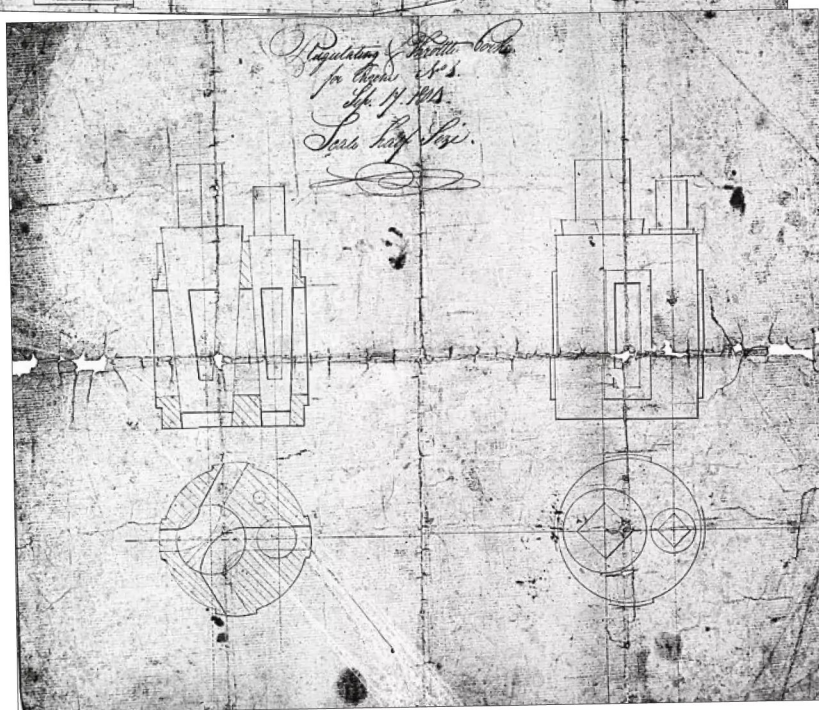


Fig. 213. Line diagram of the main steam valve for the first Wylam locomotive. Science Museum Group Collection 1873-28.

References and footnotes

381 The Patent Office Museum was merged in 1884 with the Science Collections of the South Kensington Museum. In 1909 the science and engineering collections were administratively separated from the Art Collections and officially named the Science Museum.

382 Francis Trevithick had four sons, two of whom seem to have been possible as the source referred to. Frederick Harvey was born Crewe 1852 and after an apprenticeship at Harvey's he went to the G.W.R. shops at Swindon where in 1880 he became Carriage and Wagon superintendent of the G.W. R., London District at Westbourne Park. After 1883 he became Chief Traction Engineer of the Egyptian State Railway. His brother, Robert Lowthian, was born in Cornwall in 1848. Again, he was a Harvey apprentice and then from April 1870 continued his training in the erecting shops at Swindon where he remained until September 1872. A year in Portugal followed after which he returned to England to take up an appointment in the drawing office of the G. W. R., moving to Derby in 1876 where he took charge of machine shop of the C. & W. works. The two other sons had no association with the G.W.R.

383. Timothy Hackworth and the Locomotive. Robert Young. Pub. The Locomotive Publishing Company Ltd. 1923. P. 39. Young was the grandson of Timothy Hackworth.

384 Lewis op. cit. M.J.T. Lewis. Steam on the Sirhowy Tramroad and its Neighbours. Pub. Railway and Canal Historical Society. 2020. P. 47. Fn. 10.

Making Small Threads



Stew Hart has designed a series of useful accessories to make the production of small threads less fraught.



Photo 1: Small Vertical Engine made using M1 Threads.

We've all broken a tap into a piece of work that we've been unable to rectify, resulting in the piece being scrapped; it's nothing to be ashamed of, it happens to the best of us. With a little bit of planning and experience we can narrow the odds in our favour. I would classify a small thread as anything less than a M3 or 6BA in old money. My experience with producing small threads came about due to a very talented model engineer called George Britnell, who made a series of very small model steam engines, that inspired me to try and make a small engine along the lines of George's engines, **photo 1**.

I didn't copy Georges' design exactly; I'm too independently minded for that. Instead, I came up with my own design that was inspired by George. The design extensively uses M1 threads. The reason I use the metric thread system was that it is the industrial standard in Europe, which means metric tools fasteners are readily available at a reasonable price.

This brings me to the problem of sourcing threading tooling of decent quality at a reasonable price. Taps and dies around the M3 size can be

obtained quite easily, but once you get below the M2 size prices start to shoot up, especially from European makers and I was dubious about the quality of supplies from Asia. However, on the basis that a lot of manufacturing is carried out in Asia, I reasoned that someone out there must know how to make decent tooling, the hard part was going to be finding the right supplier.

To start the ball rolling I bought a box set of taps and dies complete with a combination tap/die wrench when I was visiting a model engineering exhibition. I saw the sets for sale on a number of the stalls at quite a reasonable price, so it was worth the risk. The set had a good range of sizes from M2.2 to M1. I wasn't too happy with the design of the combination wrench, I thought



Photo 2: Box set of taps and dies with unsuitable wrench.

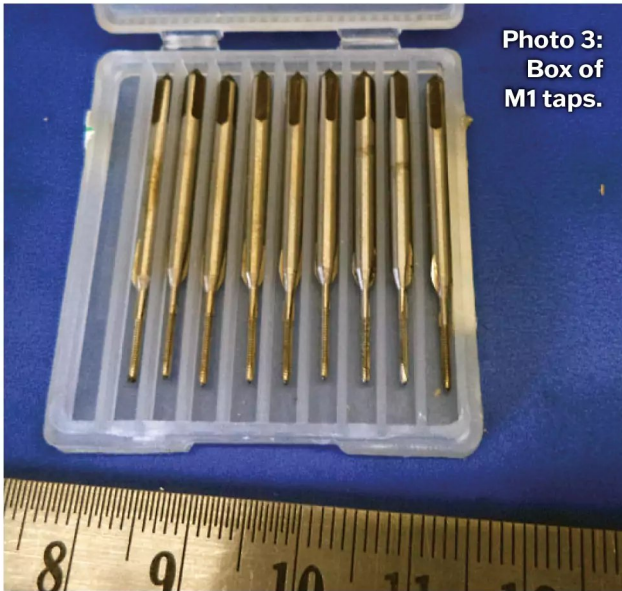


Photo 3:
Box of
M1 taps.



Photo 4:
Wrenches
and
holders
that are
too big.

it was too big for the taps and dies it was intended to be used with. I carried out a trial and ended up breaking two of the taps. I put this failure down to the wrench not giving me a sensitive enough feel to avoid over loading the taps and breaking them. The dies weren't split dies, they were solid more like a die nuts, but they did seem to produce a reasonable thread, **photo 2**.

I carried out an extensive Internet search, and was pleasantly surprised when I found on one of the trading sites a Hong Kong firm selling a dozen second taper M1 taps for less than £15 including postage, so I took a chance that the quality would be okay. I wasn't disappointed. With care I was able to produce the complete engine with

these taps. I only broke one tap due to trying to grind a flat on it to convert it to a plug tap, a conversion I managed to achieve with an oil stone, **photo 3**.

After a couple of false starts I managed to find some split dies at a reasonable price, but they performed no better than the dies from the set. Rather than make the small screws and nuts, I wanted to buy these from a supplier. The usual model engineering suppliers I tried didn't stock metric M1 fasteners, but I figured that as metric is the industrial standard there must be a supplier out there. Eventually, with an Internet search I found a firm who would supply me with slotted screws and nuts.

Small threading tools require small



Photo 5: A small
tap wrench with
its inspiration.



Photo 6: Forming
the handle with
a radius tool.



Photo 7:
Centring
using ruler,
pointer and
Mk1 eyeball.



Photo 8: Drilling and milling flat.



Photo 9: Drilling and tapping.

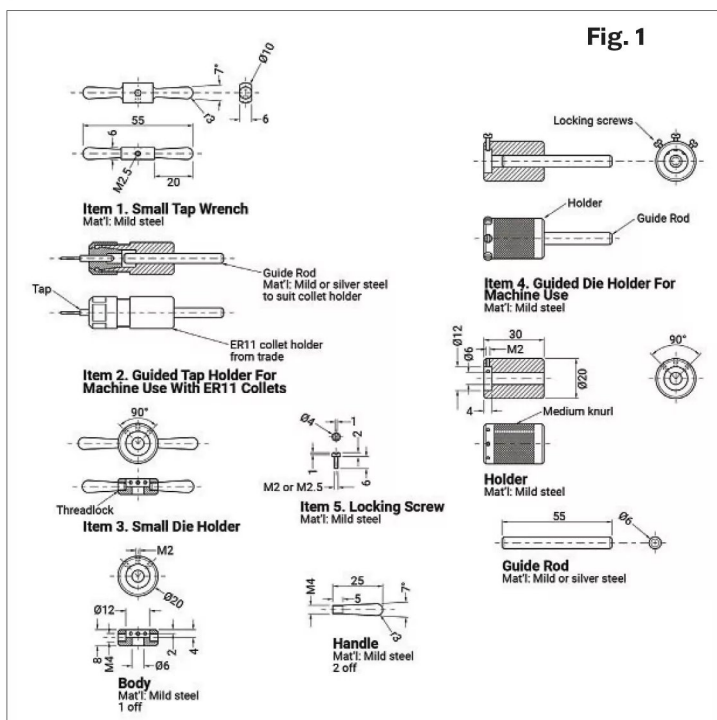


Photo 10: Boring out the die holder.

holders and wrenches, which is perfectly obvious when you think about it. Small holders and wrenches give you the fine feel and control that avoids breakages. The problem was, I didn't have anything suitable, and there was nothing available on the market, so I would just have to make something, **photo 4**.

There are plenty of different designs for wrenches and die holders around, but I had very specific requirements of

being suitable for small threads, and the ability to start a thread square in the work piece. I eventually came up with a number of designs of wrenches and die holders, **fig. 1**. The inspiration for the tap wrench came from a small wrench I picked up from one of our club's tool jumbles, it was in a box of other odds and ends that no one seemed to want. Whoever had made this wrench had made the centre too narrow and the through hole had broken

through. Despite this it still worked well enough for me to try out, and the design flaw was easily corrected, **photo 5**.

ITEM 1

This tap wrench was made from a piece of 12mm diameter mild steel turned down to 10mm, then with the compound slide slewed over 3 1/2 degrees and using a radius tool the handle was formed. It was parted off to



Photo 11: Drilling die holder using spin indexer.



Photo 12: Parting off.



Photo 13: Taping die holder with small wrench. Note use of cutting CT90 cutting fluid and the tap not gripped on the square.



Photo 14: Forming the handle.

length, flipped round in the chuck and a handle produced on the other end. Over on the mill, using a ruler, pointer and the 'mark one eyeball' to level the ruler and bring the mill on the centre, I spot drilled and drilled through 3mm diameter, then milled a flat. I flipped it over on a parallel then milled to a thickness of 6mm. Finally I turned it on its edge, set it on centre using the trapped ruler trick and drilled and tapped M2.5, job done, **photos 6-9**.

ITEM 3

The die holder to go with the wrench was made from a piece of 25mm diameter mild steel turned down to 20mm diameter then drilled through 6mm. A short step was drilled out 10mm and the 12mm bore finished off with a boring bar for a loose fit on the die. The piece was then transferred over to my spin indexer and the holes drilled for the M2 and M4 threads. I was too

close to the chuck to tap the threads on the machine, so it was gripped in the vice and using the small tap wrench the holes were tapped. The job was transferred back to the lathe for parting off. The handles were made in a similar way as for the wrench, but they were threaded M4 for screwing into the holder and were secured in place using thread lock, **photos 10-14**.

I was using ordinary Philips screws in the wrench, but I decided to make some slotted screws, Item 5, just to



Photo 15:
Cutting the
screw thread
on the lathe
with a guided
holder.

neatly finish the job off. I made the screws from some 5mm mild steel bar and skimmed the diameter, then turned a 6mm length down ready to cut the thread on using a small guided die holder. Before parting off I chamfered the head of the screw, then using my universal tool post attachment I put in a nice deep screw driver slot, **photos 15-18.**

It is important that you start a tap off square, particularly when it comes to an assembly. If the threads are not square the studs will be leaning this way and that and at different angles, and the parts will not fit. You will have to resort to opening out the clearance holes or filing it oval to get it to fit. The solution is to use the built-in squareness of your machines to get your threads square or, for certain applications, use a tapping table. There are quite a number of different designs of holders for use on machines, but my preference is for a simple holder and guide rod gripped in the machine chuck, see Item 4. These are easy to make in various sizes to suit the sizes of dies and taps being used, I have quite a collection of these die holders, some I made myself, others I've picked up on my travels, **photo 19.**

ITEM 2

This is a guide rod type tap holder - the usual way to hold the tap is to use a Jacobs type drill chuck, attached to a bush drilled to take the guide rod, but the complete assembly is quite long, magnifying any slack at the tap,



Photo 16: Cutting the slot.



Photo 17:
Universal tool
post fixture.

increasing the chance of a breakage. Using an ER11 collet instead of the chuck makes for a more compact assembly reducing the slack at the tap and so reducing the risk of a breakage, **photos 20 and 21.**

That's the wrenches and die holders sorted, so here are a few tips on actually cutting the threads. I have a SEIG X3 milling machine that has a built-in tapping function. This is a simple reversing mechanism that operates at low speed through buttons in the handles; I've used this feature regularly to tap threads down to M3. I've never used it on threads less than this because of the breakage risk. However, using this function taught me one very useful little tip: don't grip the tap too tight in the chuck. As soon as you see the chuck slip on the tap, press the reverse button, let it come back two or three turns, press the button sending it forward to cut two or three turns until it spins again and repeat the procedure. This stops you overloading the tap and breaking it.

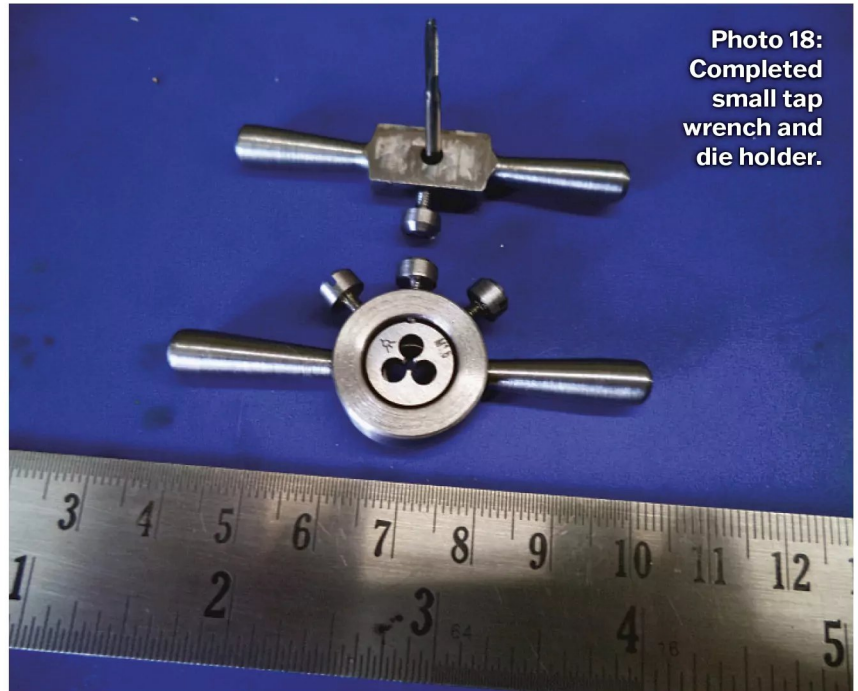


Photo 18:
Completed
small tap
wrench and
die holder.

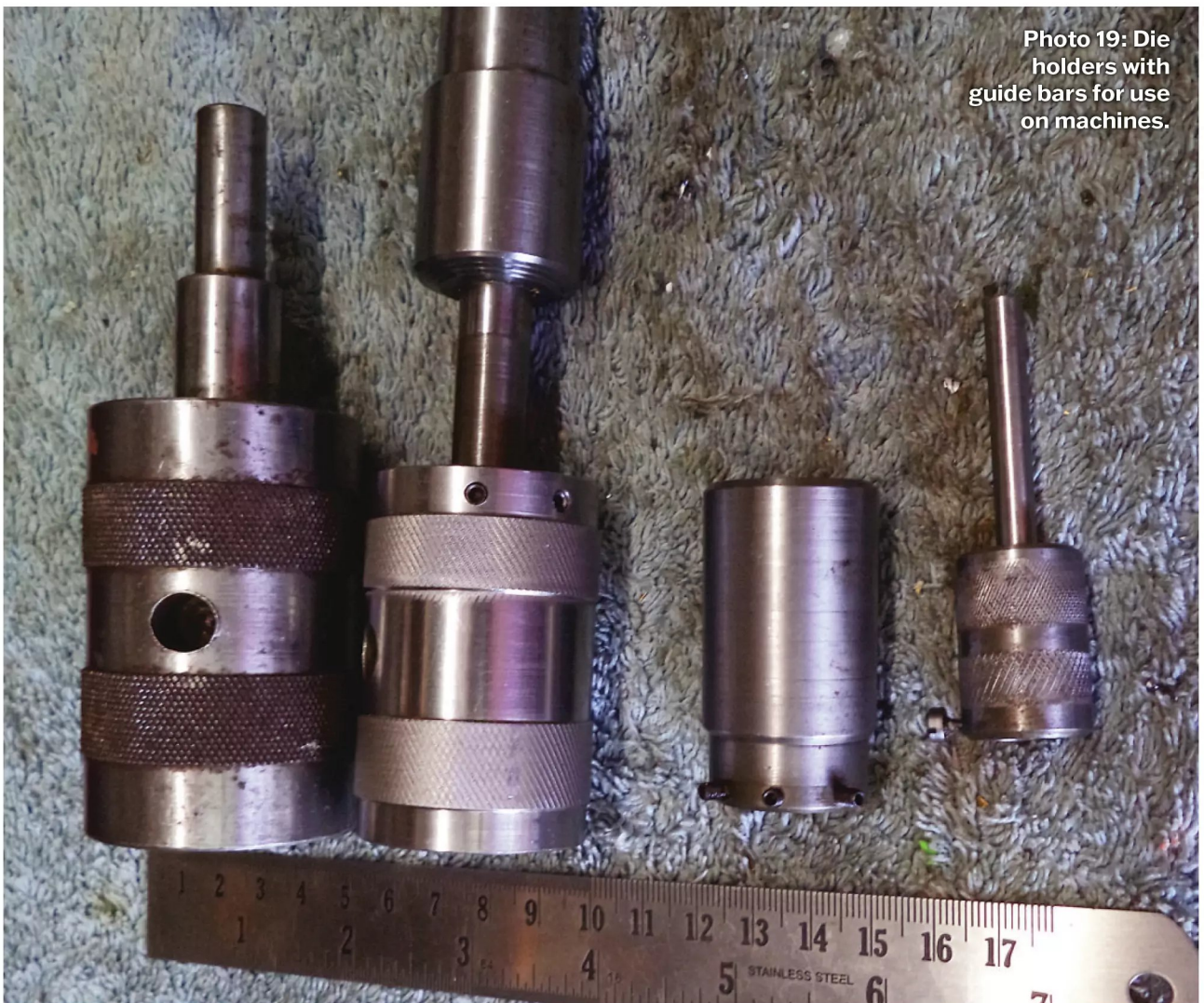


Photo 19: Die
holders with
guide bars for use
on machines.



**Photo 20: Guide bar
Jacob's chuck tap holder
and small compact holder
using ER11 collet holder.**



**Photo 21:
Using the
Guided ER11
tap holder
in the mill.**

This brings me to a useful observation; taps are supplied with a squared end for the tap wrench to drive on. I never clamp on this square section when using small taps, I prefer to clamp on the round section. When the wrench starts to slip, this is my signal to back off and ease the load on the tap and clear the chips. Also, use the next size up from the recommended tapping drill size. This will significantly reduce the loading on the tap with only a negligible reduction in thread strength.

Always chamfer the hole to help the tap start. Use tapping and threading fluid as again this reduces the loading and is particularly useful when tapping a blind hole as the chips will stick in the flutes preventing the hole from blocking up. You must remember to clean the tap flutes regularly as blocked flutes will increase the loading.

When cutting with a die always chamfer the bar to give the die a start. Back the die off every turn or so to free the chips. Use cutting fluid and, as for taps, don't let it block up.

If you are using a split die, you can adjust the thread by tightening or slackening off the three screws. Backing off the centre screw and tightening the two outer screws will close the die in reducing the size of the thread, tightening the centre screw and slackening the outer screws will open the die up increasing the size of the thread. I always start off with the screws just nipped up to check how the die cuts and then make any necessary adjustments.

I hope you will now be able to tackle small threads with a increased confidence. Just remember to use an appropriate size wrench and die holder. 🛠️

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Working of Steam Boilers {1923} DIGITAL EDITION • £ 7.65

This is a DIGITAL EDITION, intended for viewing on comput-
ers and laptops, but not Android devices.
The book's full title is the "Working of Steam Boilers: being
instructions respecting the Working, Treatment and Attendance of
Steam Boilers. For the use of Boiler Attendants, and those in charge
of and responsible for Steam Boilers" which just about sums it up.
The first 102 pages refer to Boilers generally, including "Lancashire", "Cornish",
and the like. The remaining 62 pages refer to special features of Vertical boilers,
Locomotive type boilers (both rail and road) water-tube boilers, Steam
Superheaters and Economisers. The section on how boilers fail in particular is
worth the cost of this book many times over. 177 pages, including index.



Metal Finishing Techniques NOW AT 40% off!! • £13.90

Alex Weiss describes methods of getting that 'right' finish on
metal, be it for fit, or for aesthetic reasons. The 10 main
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Scraping, Bare Metal Finishes (these include plainishing and
peening, chasing and repoussé, engraving, knurling, oil or
grease coating, other rust barriers and etching), Metal
Colouring and Painting. You will not learn every last-thing on these subjects from
this book - there is, after all, only so much that can be put into 120 A4 format
pages, there is a huge amount of relevant information here, which any model
engineer will find useful. I learnt a lot from this book! High quality paperback, full
of B&W photos, and diagrams.



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Ffestiniog Railway, in the Sudan and especially in South Africa
on the 2 foot gauge Alfred County Railway where he rebuilt
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Further work involved broad gauge steam in Australia and
Russia and narrow gauge steam in Argentina. Forty five of this
books 136 pages concentrate on Phil's work on the Ffestiniog, with a similar
number on his time with the ACR. No punches are pulled in this technical, but
high readable and entertaining account of a life with steam, illustrated
throughout with many of the author's and others colour photographs from
Wales, the Sudan, South Africa, Australia, Russia, China and Argentina. Numerous
technical drawings, charts and diagrams. 136 pages. Hardbound.



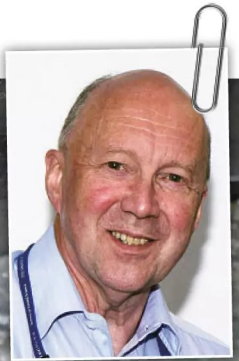
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A Tandem Compound Mill Engine



PART 14

David Thomas cuts the bevel gears for Arnold Throp's Corliss Mill Engine design.

Photo 211: Machining a pinion blank.

The original drawings call for governor gears of 64 DP, 15 and 60 teeth which I was unable to source, if someone does find them in small quantities please write to the Editor or the Forum and let us know. Far eastern suppliers have module 0.5 pairs of bevels with ratios up to 3:1 but 4:1 doesn't seem to exist. If the 4:1 step-up bevels remain impossible to get I can think of three alternative

approaches for getting the governor at least appearing to work:

- 1) Redesign for a 3:1 ratio which is certainly possible but may require the gear housing to be modified.
- 2) Eliminate the gears altogether, leave the externals of the governor as is for appearance and use electronic controls and a servo to actuate the linkages, also a heck of a lot of work.
- 3) Make your own gears, which is

what I chose to do.

Number three is a lot easier to write than to carry out and Bob Reeve's article on High Ratio Bevels, ref. 1, didn't appear until over a year after I was trying to make my set. Bob's earlier three articles, ref. 2, made it possible for me to produce working bevels even if the pinion wasn't up to Bob's high standards.

The procedure for cutting parallel

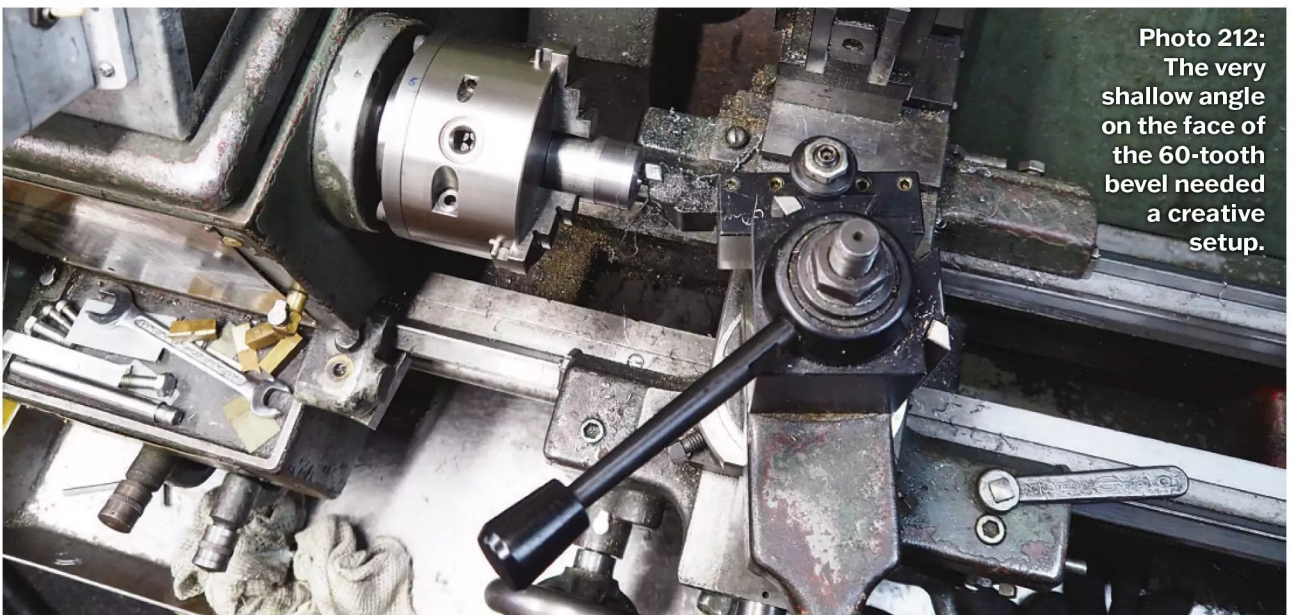


Photo 212: The very shallow angle on the face of the 60-tooth bevel needed a creative setup.

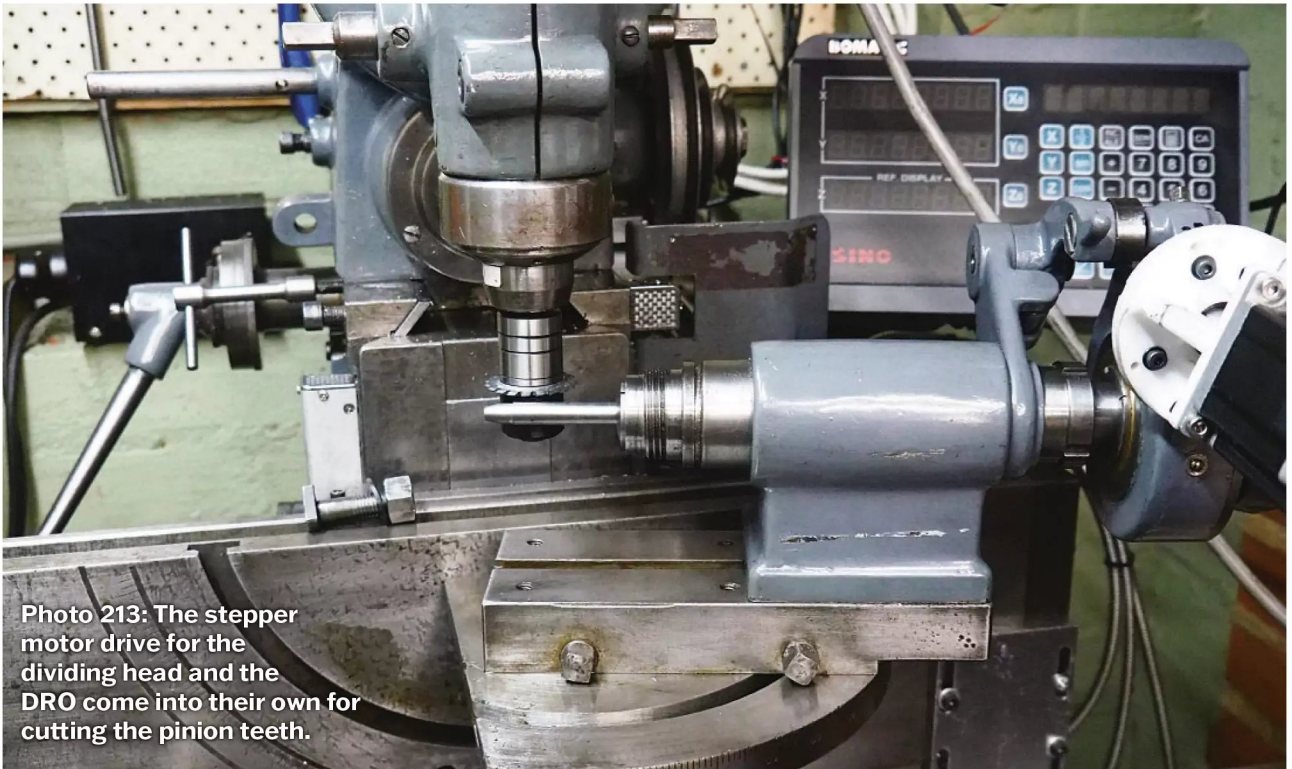


Photo 213: The stepper motor drive for the dividing head and the DRO come into their own for cutting the pinion teeth.

depth bevel gears is described in Ivan Law's book, ref. 3, which has errors corrected by Bob Reeve, and in Dave Lamas' articles, ref. 6, so I won't repeat it here. The roll angles and offsets for cutting the two bevels by the method given in the references are detailed in **fig. 2**. My progress through making the gears is shown in **photos 211 to 214** with the final products in **photo 215**. The 60 tooth gear works out very well and the pair drive the governor satisfactorily, but the 15 tooth pinion is a compromise and there is room for more experiments there. The method described in Bob Reeve's second instalment ends up specifying a #7 cutter (which is intended to cut 75-134 teeth in a module series) which looks wrong but does work. I'm aware that thinner B&S cutters are made specially for cutting bevels but guessing that these are expensive, one way forward would be to try making a one-off cutter for the job. **Figure 3** was created in Alibre, using the gear generating toolbox contributed by "stepalibre". This shows the tooth forms that the bevels should have to be correct, and the 60 tooth gear teeth look very much like these. The actual pinion however has very thin teeth with straight sides, not surprising considering the use of a #7 cutter.

The original drawings don't describe the type of belt to be used to drive the governor, but the pulley shape suggests that it should be flat. On Arnold Throp's original model in the Powerhouse Museum the belt is flat and has a



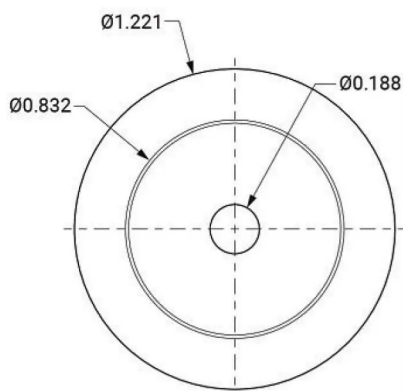
Photo 214: The first attempt at the large bevel was in steel the later, successful, one was brass.



Photo 215: The gears so far, it's just possible to see that the teeth on the pinion are very thin.



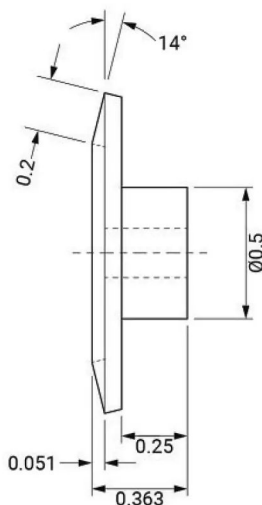
Photo 216: The sliding jig to help with joining the drive belts.



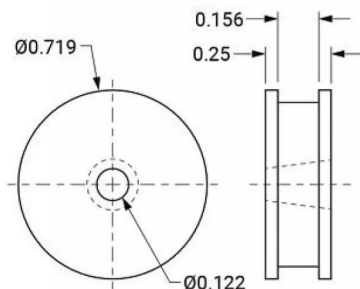
60 Tooth Bevel Gear

Mat'l: Brass, 1 off
Module 0.5

N.B. Module gear cutters are numbered in the reverse order to Imperial ones

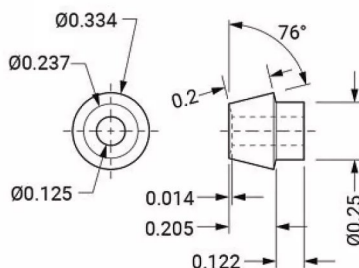


60 tooth bevel
For milling a constant depth bevel the roll angle is 1.45 & the vertical offset 0.015
Use a #8 cutter
Tooth depth = 0.044



Pulley

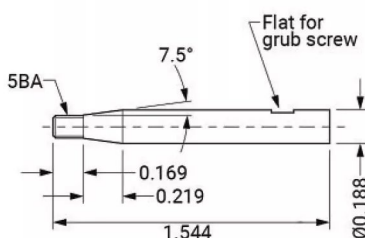
Mat'l: Mild steel, 1 off



15 Tooth Bevel Gear

Mat'l: Mild steel, 1 off
Module 0.5

15 tooth bevel (see text)
For milling a constant depth bevel the roll angle is 1.45 & the vertical offset 0.0038
Use a #7 cutter
Tooth depth = 0.044



Pulley Shaft

Mat'l: Mild steel, 1 off

Figure 2: Governor gears



Photo 217: Twin drive belts work well and look something like the originals.

visible lap joint but with the model in a museum case it isn't possible to work out what the material is. Five-millimetre-wide turntable drive belts are available online, so I started with one of these and cut and joined it to get the length right. This persisted in running off the pulleys and I gave up trying to adjust things to work and moved on to using 2 mm O-ring cord to make round belts. Joining this material is easier if you make a jig to hold the ends and bring them together after applying a blob of cyanoacrylate glue, I copied and scaled down a jig described in the Hemingway instructions for joining the belting for the Universal Pillar Tool, **photo 216**. The stl files for this are available at www.model-engineer.co.uk. **Photographs 17 and 18** show the belts in place.

References

1. Bob Reeve, *High Ratio Bevels*, *Model Engineer's Workshop*, Issue 322.
2. Bob Reeve, *Bob's Better Bevels*, *Model Engineer's Workshop*, Issues 316, 317, 318.
3. Ivan Law, *Gears and Gear Cutting*, *Special interest Model Books*, 2003. ISBN 978-185242-911-2
4. Dave Lamm, *Gear Cutting*, series in *Model Engineer*, issue 3883 et. Seq. To be continued.

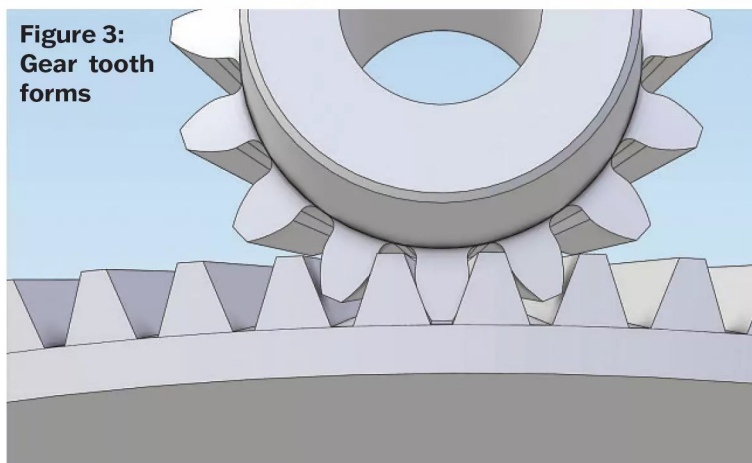


Figure 3:
Gear tooth
forms

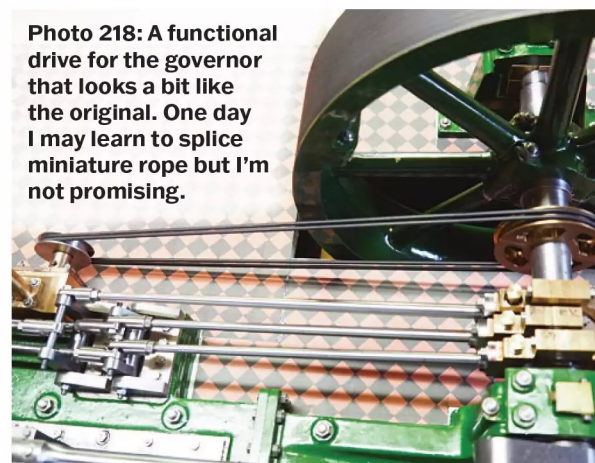


Photo 218: A functional drive for the governor that looks a bit like the original. One day I may learn to splice miniature rope but I'm not promising.

Photo 10: Another way of holding a small gear for boring. A recess has been bored in a piece of aluminium. The gear is a light push fit in the recess, but is further secured by superglue.

A Workshop Diary

PART 2

Monday

Alex du Pre concludes his look at using superglues for workholding in the lathe.

Photo 11: A smaller mandrel in use for another gear. Tailstock support is used while the glue bonds and during machining for extra security.



Last time I machined the first gear, by supergluing it to a special mandrel. The whole process is then repeated for the next gear, it only being necessary to lightly re-face the mandrel to remove the glue residue and confirm flatness. For reference, **photo 10** shows an alternative method to bore a gear after cutting, and **photo 11** is a small gear blank being readied for machining.

This is a suitable workholding method

for any thin workpiece, disc-shaped or otherwise, and especially where there is no bore by which to hold the work. Although other methods are possible, this is a quick and easy way to machine a disc to a precise thickness and diameter, or to machine any suitable thin part to the required thickness.

This is also an especially helpful way to hold small and awkwardly-shaped parts, the selector forks on my gearbox being a case in point. These are fiddly

pieces about 25mm in length and 2mm thick, **photo 12**, with a 16mm semi-circular hole bored into them, which fits into a groove in the dog clutch. Although these could be filed to shape – and were on the outside edges – laziness dictated that it would be easier to machine the bore. If cutting the parts from a large sheet of steel, the holes could be drilled or bored relatively easily on the mill, there being plenty of material to hold the work by before cutting out the parts. But being the parsimonious chap that I am, I much prefer to use up small offcuts from the scrap bin. The solution, as you will have guessed by now, was to glue the part to the mandrel used for the gears and bore it that way, **photo 13**. The centre of the bore had been marked out and centre-drilled and this was used to locate the part on the mandrel with the tailstock centre. This was entirely successful and there was practically no other way to hold these parts short of just filling everything in the vice. **Photo-graph 14** shows machining a dog clutch on a gear that has already had a slot for the selector fork grooved in it.

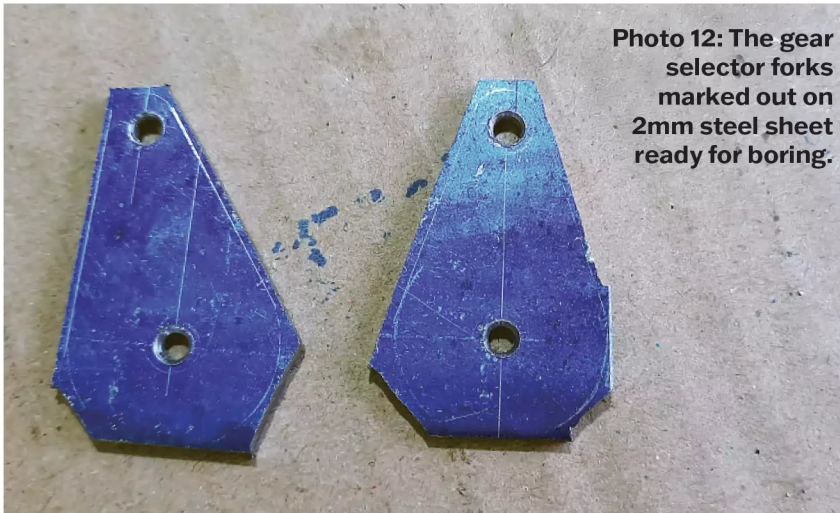


Photo 12: The gear selector forks marked out on 2mm steel sheet ready for boring.

SOFT JAWS

Continuing with the gears, once the teeth were cut, some gears needed further machining which could not have been done earlier whilst still bonded to the mandrel. One way to hold gears is to grip them in a bore machined in soft jaws in the lathe chuck. Some chuck jaws have tapped holes in them that can be used for attaching aluminium soft jaws, however, not mine. I chickened out of attempting to make holes in my chuck jaws, so, encouraged by my supergluing exploits so far, thought I would try glueing some aluminium blocks to the jaws instead.

Finding three suitable aluminium blocks in my ever-bountiful scrap bin, these were cleaned and glued to



Photo 13: One of the selector forks glued to the mandrel for boring.

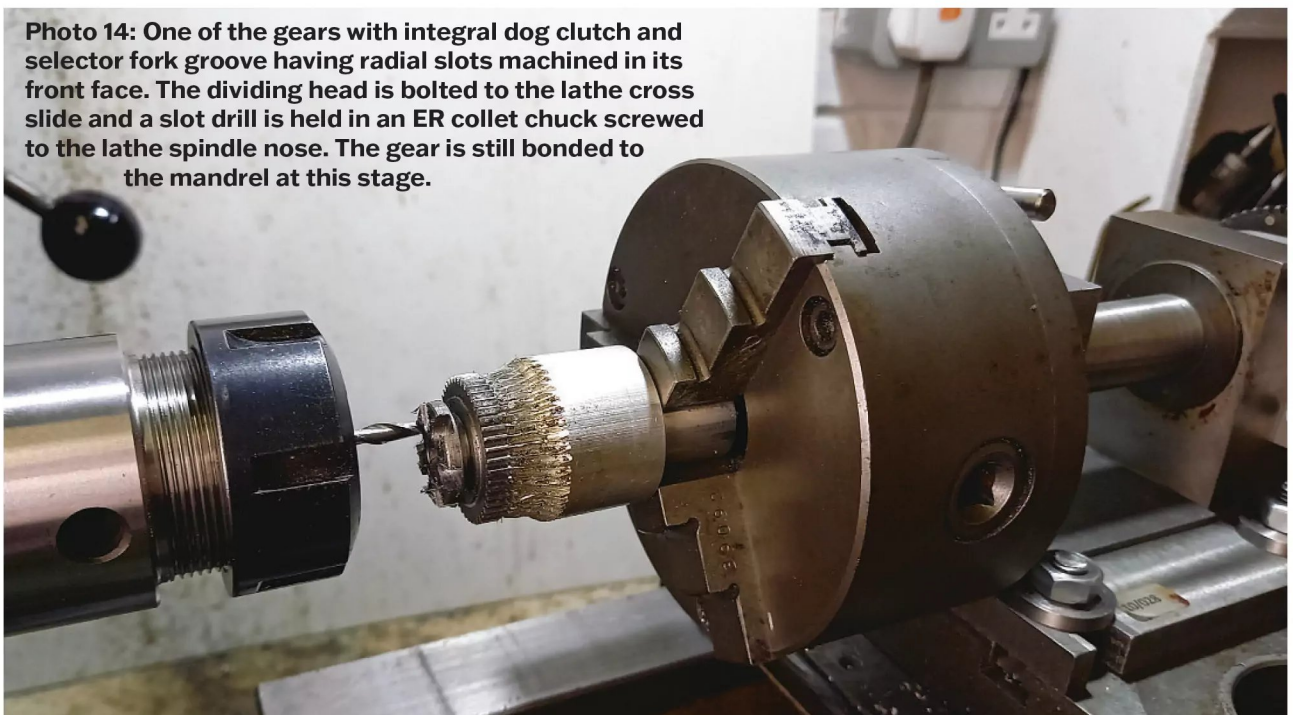
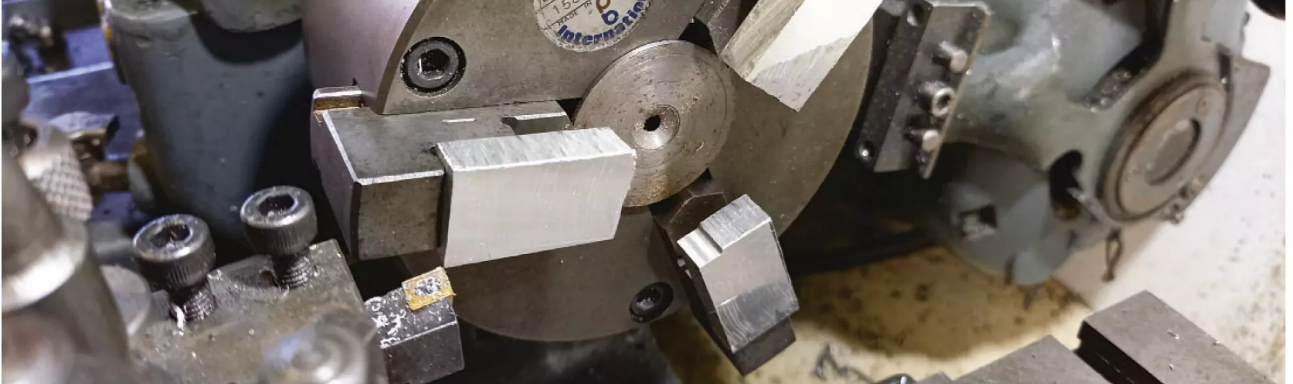


Photo 14: One of the gears with integral dog clutch and selector fork groove having radial slots machined in its front face. The dividing head is bolted to the lathe cross slide and a slot drill is held in an ER collet chuck screwed to the lathe spindle nose. The gear is still bonded to the mandrel at this stage.

Photo 16: Facing (not really necessary) and boring the soft jaws The hard jaws have been tightened against the steel disc seen in the centre of the chuck to take up the slack.



the face of the reverse jaws, which were also cleaned, butting them hard up against the shoulders on the jaws, **photo 15**. They were then faced (mainly for fun and to test the bond) and bored to fit closely on the gear, with an internal shoulder made so that the gear was held flat and concentric, **photo 16**. When machining lathe soft jaws, the underlying hard jaws need to be tightened up against something to take up the slack in the chuck mechanism. I used a metal disc and then drill shank of an appropriate diameter at different stages in the work.

Soft jaws allow very accurate work, **photo 17**, even when using a worn-out old chuck. In my test, the glue method worked well, although I would especially advise the use of light cuts and slower spindle speeds so that no harm will be done if the glue lets go. I would not advise this approach for larger lathes where the inherent kinetic energy is much higher. As for any work, avoid over-tightening the chuck jaws, although the bulk of the forces are taken by the shoulders and not the glued joint. Good surface preparation to achieve a sound glued joint is key, otherwise this is not going to go well. So, be mindful of the safety implications as always.

CONCLUSION

For me, solving workholding challenges, **photos 18** and **19** is one of the more satisfying aspects of machining. Setting up a machining job is quite often by far the most time-consuming and difficult stage and having the right accessories and knowledge of the options is key to making good progress. The solution to some setting up problems might just lie in a small bottle of superglue. The method also provides opportunities for milling work, which we will see next time. ●

Photo 15: Aluminium soft jaws bonded to the chuck jaws, ensuring they are supported by the shoulders on the jaws.



Photo 17: The soft jaws have been bored to accommodate a small gear, which is having a shallow recess bored into its outer face.



Photo 18: The gear blanks before...



Photo 19: ...and after machining.



Club Diary

Please send your events for Club Diary to meweditor@mortons.co.uk

2025

Every Sunday

Warrington MES
Running day. Contact :
contact@wdmes.org.uk

19 Leeds SMEE
Barry Thurgood – 'Buckling
& Bolting'. Contact: Judith
Bellamy,
jabellamy29@gmail.com

21 Rochdale SMEE
Bits and pieces/bring a
model. Castleton Commu-
nity Centre, 19:00. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

APRIL

2 Leeds SMEE
Spring clean your work-
shop auction. Contact:
Judith Bellamy,
jabellamy29@gmail.com

6 Guildford MES
Small Model Steam Engine
Group meeting, 14:00-
17:00, Stoke Park. Contact:
Mike Sleigh, pr@gmes.org.uk
or see www.gmes.org.uk

9 Warrington MES
'Natter Night' at the Walton
Arms. Contact:
contact@wdmes.org.uk

13 Guildford MES
Public open day, Stoke
Park. Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

16 Leeds SMEE
Nigel Bennett – 'Invicta'.
Contact: Judith Bellamy,
jabellamy29@gmail.com

18 Rochdale SMEE
Nattering in the hut
(Community Centre
closed). See [www.
facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

MAY

2 Rochdale SMEE
Models running night.
Springfield Park,
17:00 onwards. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

7 Leeds SMEE
John McGoldrick – Leeds
Museums. Contact: Judith
Bellamy,
jabellamy29@gmail.com

10 Bromsgrove SME
Open Day All gauges are
welcomed 5", 3.5", 2.5", G1
and 16 mm. Contact Doug
Collins 07585 524836

16 Rochdale SMEE
Alf Molyneux – 'Trav-
els with Fred Dibnah'.
Castleton Commu-
nity Centre, 19:00. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

18 Guildford MES
Public open day, Stoke
Park. Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

21 Leeds SMEE
Geoff Rogers – Traction
Engine. Contact:
Judith Bellamy,
jabellamy29@gmail.com

29 Guildford MES
Public open day, Stoke
Park. Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

JUNE

1 Guildford MES
Small Model Steam Engine
Group meeting, 14:00-
17:00, Stoke Park. Contact:
Mike Sleigh, pr@gmes.org.uk
or see www.gmes.org.uk

6 Rochdale SMEE
Models running night.
Springfield Park,
17:00 onwards. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

6-8 Cardiff MES
Welsh Locomotive Rally,
Heath Park. Contact:
Ross Hopkins, [rally@
cardiffmes.com](mailto:rally@cardiffmes.com) or
see www.cardiffmes.co.uk
ww

8 Guildford MES
Public open day, Stoke
Park. Contact: Mike
Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

20 Rochdale SMEE
Bob Hayter – 'Evil Spirit'.
Castleton Commu-
nity Centre, 19:00. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

JULY

4 Rochdale SMEE
Models running night.
Springfield Park,
17:00 onwards. See
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RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)
5/6 Guildford MES
Railway Gala, 10:00-17:00,
Stoke Park. Contact:
Mike Sleigh, [pr@gmes.
org.uk](mailto:pr@gmes.org.uk) or see [www.gmes.
org.uk](http://www.gmes.org.uk)

5 Bromsgrove SME
Modern Traction Open
Day. All gauges welcomed
5", 3.5", 2.5", G1 and
16mm. Contact Doug
Collins 07585 524836

18 Rochdale SMEE
General meeting. Spring-
field Park, 17:00 onwards.
See [www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

20 Guildford MES
Public open day, Stoke
Park. Contact: Mike
Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

AUGUST

1 Rochdale SMEE
Models running night.
Springfield Park,
17:00 onwards. See
[www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

3 Guildford MES
Small Model Steam Engine
Group meeting, 14:00-17:00,
Stoke Park. Contact: Mike
Sleigh, pr@gmes.org.uk
or see www.gmes.org.uk

7 Guildford MES
Public open day, Stoke Park.
Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

15 Rochdale SMEE
Auction Night. Castleton
Community Centre, 19:00.
See [www.facebook.com/
RochdaleModelEngineers](http://www.facebook.com/RochdaleModelEngineers)

17 Guildford MES
Public open day, Stoke Park.
Contact: Mike Sleigh, [pr@
gmes.org.uk](mailto:pr@gmes.org.uk) or see [www.
gmes.org.uk](http://www.gmes.org.uk)

28 Guildford MES
Public open day, Stoke Park.
Contact: Mike Sleigh, [pr@
gmes.org.uk](mailto:pr@gmes.org.uk) or see [www.
gmes.org.uk](http://www.gmes.org.uk)

SEPTEMBER

6 Bromsgrove SME Open
Day. All gauges welcomed
5", 3.5", 2.5", G1 and 16mm.
www.bromsgrovesme.co.uk.
Contact Doug Collins 07585
524836

A Four Inch Garrett Agricultural Engine

Alan Barnes visited Chris Barham to see his magnificent 4-inch to the foot (1:3) model traction engine, Archie.



For Chris Barham the construction of his 4-inch Garrett Agricultural Engine can hardly be described as a rushed job as the project began in 1997 and he is still tinkering with the engine today, **photo 1**.

Chris is an experienced engineer having served an apprenticeship

as a marine fitter and turner and he then worked in shipyards and power stations and finally working at the Thames Barrier. In 1997 he turned his attention to the construction of a 4-inch scale Garrett having obtained the drawings prepared by Bill Newcombe.

The decision was taken to prepare

his workshop first, so the old original garage was replaced by two precast garages where the work started. These were later replaced by a large, block built, workshop with a 415 volt electricity supply. This provided not only space for the equipment but also room for the Garrett as the build progressed, **photo 2**. The extensive range of machines and tools included a Harrison M450 lathe, a 6-inch Warco lathe, a Bridgeport Mill, a large floor standing slotting machine, a 20 ton press, a 7cwt anvil welding bench with an Oxford welder, 10 inch horizontal band saw, a Startrite bandsaw, Meddings pedestal drill, a Henry Milnes milling machine and an air compressor.

Chris ordered most of the required castings from D & S Engineering; the smaller boiler fittings and other parts were sourced through Live Steam Models and Yorkshire Model Engineering Supplies which were both very helpful. If Chris had begun the project a few years earlier Chris would



Photo 2: The engine inside the workshop (Chris Barham).



Photo 1: Chris on the Garrett in May 2018.



Photo 3:
1919 Garrett
No 33442
at Bredgar
which Chris
photographed
in detail.



Photo 4: The worm steering gear.

have been able to make the boiler himself as he had at one time been a coded welder. The order for the steel welded boiler was eventually placed with Bell Boilers.

While the drawings were very detailed, they had been prepared with a view to building a scale model and had certain limitations. Chris wanted his model to be as accurate as possible and arranged to photograph and measure two of the surviving full size Garrett engines.

Chris was able to take detailed measurements of The Earl of Eldon, works number 28758, thanks to the engine's owners the Loader family. This Garrett was photographed and

studied during the rallies at Netley Marsh and the Great Dorset Steam Fair. He also made a number of visits to see the 1919 Garrett General Purpose Traction Engine Number 33442 at its home at the Bredgar and Wormshill Railway in Kent, **photo 3**. Owner Bill Best allowed Chris free rein to photograph and measure various details of this engine.

The additional information was used to amend certain aspects of the scale drawings. Chris found that although working directly from scale drawings was not really a problem but getting the feel of the real engine gave him an appreciation of finer points which were not immediately apparent from the plans, **photos 4-9**.

With the castings and boiler on order Chris began working on the wheels with all the parts being cut from sheet steel and fabricated in his workshop, **photo 10**. Even before the project had begun, he had decided to make as much of the engine as he could and the only jobs which were outsourced were the building of the boiler and the fitting of the tyres which was done by B H Leake & Sons in Birmingham. He machined all the

castings and fabricated the other parts in his workshop. For the fabrication of some of the parts Chris made various jigs, rollers and formers and sometimes the making of a particular jig took far longer than actually making the required part. However, as Chris told me "I do prefer fabricating parts and if I was to tackle such a project again I would avoid the use of castings wherever possible and fabricate all the parts".

Having completed the wheels a start was made on the front end of the Garrett and steady work resulted in the completion of a unit which included the front wheels, axle, smokebox, smokebox door and the chimney, **photo 11**. The completion of this section took some considerable time as Chris was still very busy with work and could only use what little spare time he had to work on the engine.

As the castings began to arrive, they were machined and set aside in the growing pile of completed parts in one part of the workshop, **photo 12**. While it is understandable that a number of engine builders will arrange for the gears to be cut by specialist

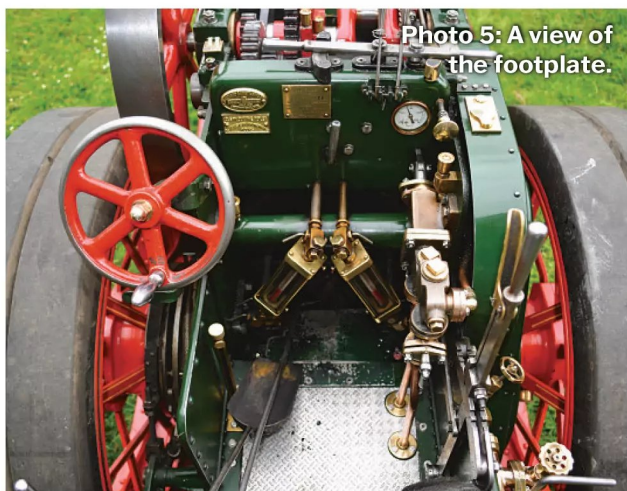


Photo 5: A view of the footplate.

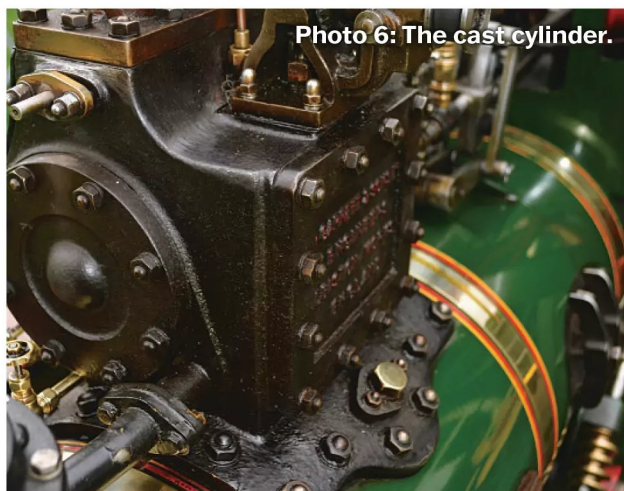


Photo 6: The cast cylinder.

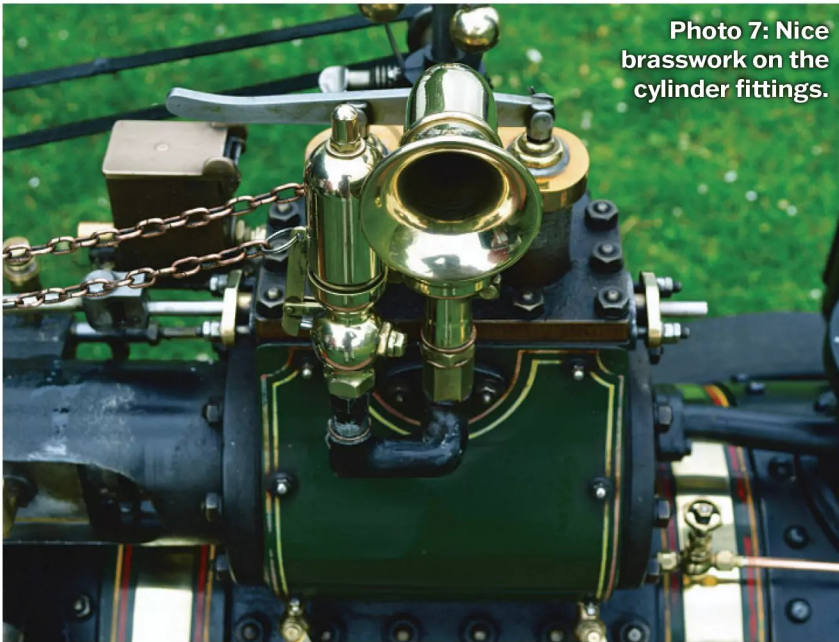


Photo 7: Nice brasswork on the cylinder fittings.



Photo 8: The flywheel.

firms, Chris was determined to carry out the work himself, **photos 13 and 14**. After all he had the right equipment and the necessary skills; all he had to do was devote his time to the work. Chris also found that doing the work himself was immensely satisfying; he recalled "as long as everything is measured and set up correctly, it is just a question of making the work as accurate as possible – especially in view of the fine tolerances required in making a 4-inch scale model".

The boiler was eventually delivered in 2004, and to make the next stage of assembly a little easier the unit was set up on a small, wheeled trolley, **photo 15**. This could easily be moved around the workshop and as the build progressed, he built another wheeled dolly which supported the front of the boiler and the rear of the engine, **photo 16**. The next task was to make the hornplates and parts for the tender and footplate which were all cut from sheet steel, shaped and riveted into position.

Next came the cylinder block which Chris had already machined and the work on the motion followed with Chris making all the parts for the



Photo 9: The toolbox and nameplate.



Photo 11: The front end (Chris Barham).

linkages, eccentrics and rods. In 2006 the engine was set up on all four of its wheels for the very first time and the "pile of bits" was now looking more like a traction engine, **photo 17**.

By his own admission the project was making very slow progress, but this was purely down to lack of spare time due to work commitments, rather than any lack of enthusiasm to complete the model. However, he did realise that there was a danger that the project would drift and never be finished. As Chris told me "There was no deadline, and I worked on the engine when I could. I enjoyed the making of the smaller parts and finishing the smaller details which I found very satisfying".

The next few years passed with the engine slowly coming together. The wheels had been fitted with their rubber tyres and had been painted red, the very first parts of the engine to receive a coat of paint. It would be some time before any paint appeared on the rest of the engine.

The Garrett may well still be incomplete today but for some friendly persuasion by the organisers of the Barleylands Rally in Essex to get Chris to exhibit his engine at the show in 2013. This invitation prompted Chris to buckle down and get the Garrett finished using all his spare time to get the work completed.

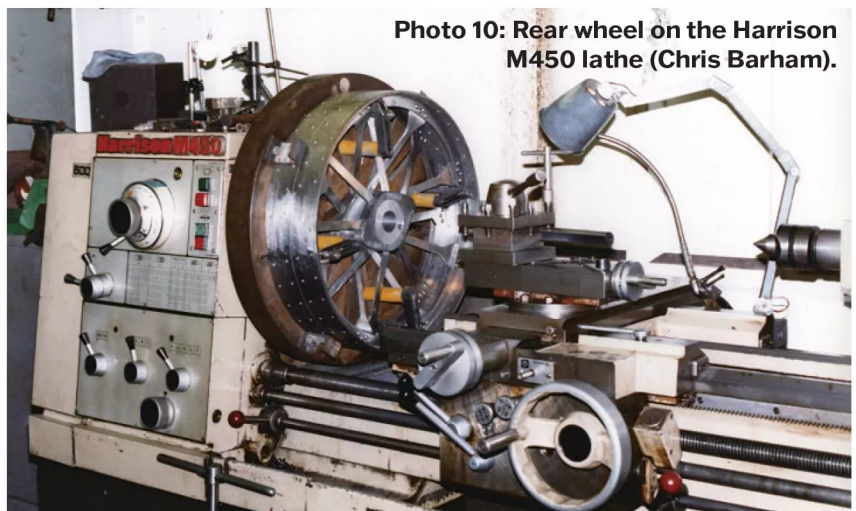


Photo 10: Rear wheel on the Harrison M450 lathe (Chris Barham).



Photo 12: Rear wheel and gears, as machined (Chris Barham).

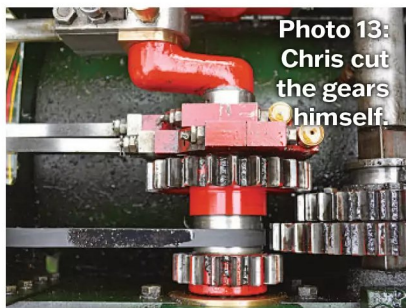


Photo 13: Chris cut the gears himself.

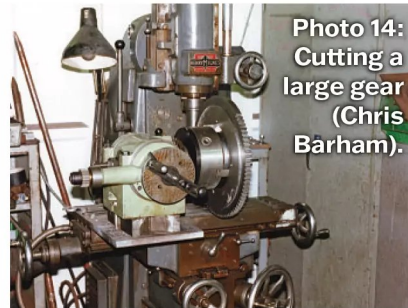


Photo 14: Cutting a large gear (Chris Barham).



Photo 15: Firebox on dolly (Chris Barham).



Photo 16: Progress! (Chris Barham).



Photo 17: On all four wheels (Chris Barham).



Photo 19: A rear view of the nicely detailed Garrett.



Photo 18: Archie under steam

A few months of hard work saw the Garrett basically complete, and test run on compressed air. Apart from the wheels, which had been painted earlier, it was still in bare metal. Having just completed the build, Chris' next task was to completely dismantle the engine and prepare the parts for painting. All the painting was carried out in his own workshop with each part receiving two coats of primer, two undercoats and then two topcoats and at one stage Chris estimated that he had thirty-two different parts hanging up to dry. When all the paint was dry Chris applied the lining a job which is much easier to handle with the engine dismantled.

Then came the work to re-assemble the engine which was completed by the Spring of 2013 a few weeks before the scheduled appearance at Barleylands, **photo 18** and **19**. With steam and hydraulic tests completed satisfactorily, the Garrett was able to make its public debut at Barleylands and it performed well.

Since then the Garrett has been rallied regularly at events in the South East and the engine has now slowly bedded in and steams very well. The initial tightness of a new engine is long gone, and Chris has a regular maintenance schedule which keeps the Garrett in first class condition. When pressed Chris would not admit to saying that the engine was finished as he is always finding parts to adjust or make slight improvements to some feature. As Chris said, "you could say that the build has now taken over twenty years, and it's still not finished".

However having seen this superb scale Garrett perhaps it only Chris who thinks it is not finished! ●

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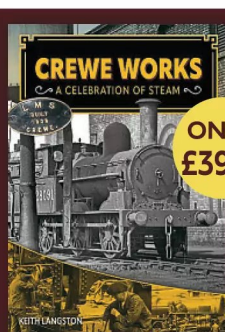
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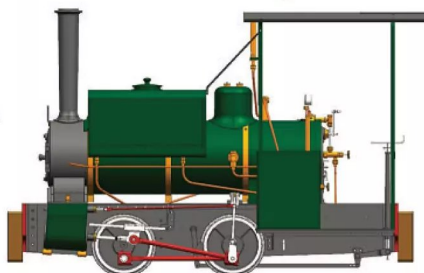


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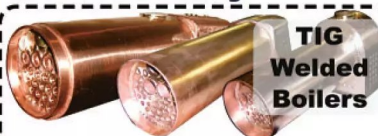
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Club News

Geoff Theasby reports on the latest news from the clubs.

Welcome to a new period in the life of this venerable and historic publication. All the editorial staff are experienced in the magazine's production, so I foresee no problems in the near future.

In this issue, a clamp, Allatd, Jetex, IKEA, helicopters, cycling, steampunk and portables.

On an official 'State visit' to **Mexborough and District Amateur Radio Society** in Conisbrough, we noticed

this imposing figure of Metal Mickey... a suit of armour. Appropriate for the origin of Sir Walter Scott's *Ivanhoe*. It also occurred to me that if anyone were to try to use a radio whilst wearing this tinsmith's product, he would find himself in an excellent Faraday Cage and be unable to conduct any radio conversations, **photo 1**.

The 140th meeting of **Model and Experimental Engineers, Auckland** was attended by the highest number to date. John Bennett reviews a book

on New Zealand's eponymous battlecruiser. On commissioning, a Maori Warriors' grass skirt was given to the ship on the condition that the Captain wear it in battle. Thus attired, the ship and crew were protected. Ultimately, there were five such warships donated by New Zealand to the Royal Navy. Chris Ratcliffe brought a barrel-type mechanical calculator, beautifully made in Germany (I used one in my employment in the 1960s). Ours was a 'Curta' and cost about £250 at the time. There is dissent amongst the members regarding the break with the Auckland Society of Model Engineers some 12 years ago. Many misunderstandings have now been clarified. The 141st meeting dated January began with a rusty old clamp of some sort which couldn't be identified. Offers are invited. Ken Poynton produced a governor for an overhead camshaft engine using gears from an old cash register and swinging weights from a box of unknown provenance. Bruce Lawson had an aircraft turn and bank indicator, the illumination of which relied upon radioactivity rather than electricity. This instrument had been on the shelf just above his head for 40 years. John Burnett showed a picture of the *Endeavour* replica and explained how it was built and worked. Graham Quayle is working on a three-inch scale Foden wagon. He found problems in fitting the drive chain due to some out of sight interference. Eventually he made a slipper to guide the chain over the obstacle and this seems to have been successful.

Stamford Model Engineer Society is quite a small club and the loss of even a small number of members may mean it could not continue. They reconvene in a couple of months to discuss the matter. John, at whose house the meetings are held, brought more automatons from Japan, one being a desk bound typist. Another, called *Ana Rexa*, is an articulated moving skeleton. The mechanism was revealed so that repairs could be carried out. The January issue has a new name and a new masthead colour: **Stamford Makers and Collectors** in green, thank you for asking. Whilst tidying up the workshop, Editor, George Dobson found a copy of *Model Car News* from 1947 priced at 1/6d. In it he found details of a 10cc E.T. Westbury engine to construct.



Photo 1: Photo 1
Ivanhoe? (Picture
courtesy of Deborah
Theasby.)

Also a review of the latest Allard (a name to conjure with; well worth a read). A German manpowered generator is pictured, two-speed chain drive allows two men to put equal effort into the transmission.

St. Albans and District Model Engineer Society newsletter has a photo of Puffing Park in autumn. Young trees, mist and low angle sunlight make it very atmospheric. The November newsletter contains Secretary, Guy Keane's apology for the skeletal newsletter, as he recently spent three weeks in the Falklands, South Georgia and Africa. Why don't polar bears eat Penguins? They can't get the wrappers off... Tony Mason writes on the history of Panhard et Levassor. Tony Ashgrove explains the interactive terms mass, weight, gravity, vertical height and barometric pressure. Tony also reviews the book, *Model Car Manual* by G.H. Deason. Full of instructions to build a modern car from plans available separately, in various styles including such power sources from rubber bands to Jetex rockets. Speaking of such things, SpaceX was not the first to have a rocket land vertically (nose down?). No, the first was the month previously, in Texas by New Shepherd. **Stalbansmes.com**.

Photograph 2 shows my Locomotive *Deborah* in its current state. For some reason the various shades of green all came from the same can of paint.

The Broadcast Engineering Conservation Group's Lineup, reveals the effort that went into the Heritage and Open Days. The monitor stack frame came in bits with no guidance as to how it could be reconstructed. No, not from IKEA! The remedy was similar, solved by laying the parts out on the floor and slowly building it up. Since then, much has been done. Some dimmers have been obtained, of the resistance type and the later thyristor type. Grants for improvements and repairs have been secured and discussions are ongoing with interested parties and volunteers. The premises have been suggested as a suitable meeting place for village functions. W. **www.becg.org.uk**.

Bradford Model Engineer Society *Monthly Bulletin* for January has Derek Brown writing on helicopters, a complicated machine where the lift is generated by a powered rotor. A relative of the helicopter is the autogyro where the lift is generated by the unpowered rotor under the influence of an horizontally generated thrust of a propeller in the usual manner. I won't mention gyroscopic precession as I know little about it (doesn't usually stop you! - Ed). Road Vehicle News from David and Mary Jackson in Australia commented on the size of the road trucks hauling goods hither and yon between the States



Photo 2: My Locomotive almost ready for testing.

and on controlling models by radio. Dominic Scholes discussed the three safest fuels for firing steam engines; a Gel 'GF', a liquid 'GDE', and meths. He concludes that meths is cheaper, weight for weight, but is not as 'safe' as the others. Jim Jennings writes about paraffin-burning oil lamps, as used by farmers in remote locations lacking gas or electricity (and my long-deceased Aunt Mary, despite having both gas and the 'lectric' in her house. Water was drawn from the village pump across the road until mains water arrived in the 1960s. All this but five miles from Scarborough). The February issue began with President, Adrian Shuttleworth noting the poor weather. Not a surprise really seeing as it's winter. Dominic Scholes has a talk on powering radio-controlled equipment with

batteries. David Jackson revealed a different sort of battery, that he found on a trip to Sydney – two 80lb cannons in the defensive positions, marked Low Moor, a Bradford foundry well known in years gone by for its high quality castings. A book review by Roger Backhouse covers the contributions made by the railways in the period after the Normandy Invasion. It is written by respected railway authority Christian Walmart and entitled *The Liberation Line*. Jim Jennings writes on Black Forest clocks, which were made in South-western Germany, allegedly during the winter when farming had to take a back seat. The article closes with some advice on how to care for and maintain such clocks. **www.bradfordmes.uk**. **The Sheffield Model Engineers** pub

quiz was as entertaining as previously. Your scribe and his amanuensis came in fourth with 30 out of 40 points. I asked for a Club News contribution for another member on an unrelated subject, but that is not yet forthcoming. Still, I may have planted a seed. **Photograph 3** was

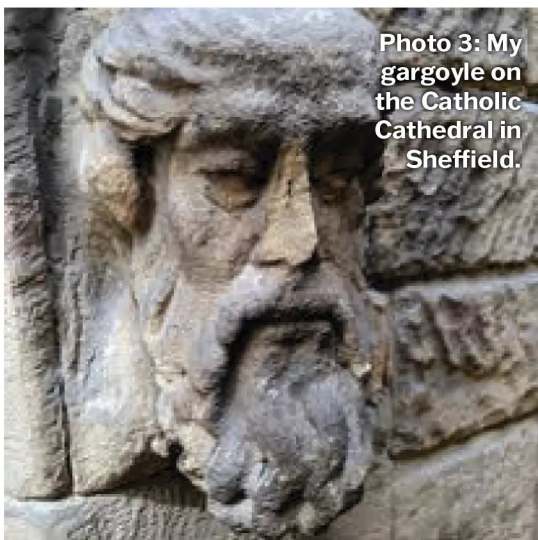


Photo 3: My gargoyle on the Catholic Cathedral in Sheffield.



Photo 4: A hiker. (Picture courtesy of Brian Eatock.)

taken in Sheffield; any resemblance to Club News compilers living or dead is entirely accidental.

The Link from **Ottawa Valley Live Steam and Model Engineers** begins with Joe Fothergill, who has almost finished his 7 1/4 inch gauge 2-4-0, locomotive. The January 'show and tell' meeting learned how to machine tungsten from Guy Cadrin. One member had a 'cycle and canal' trip to Holland which involved renting a bike rather than a barge for the day. The direction finding is interesting; major junctions on the cycle network are numbered 1 to 99. Navigation is by junctions so, in theory, you can't get lost. All you need is a list of numbers - no maps and no street names to puzzle over. He visited the De Cruquius steam engine, the largest in the world, driving eight beams set radially around a huge central cylinder. I must apologise for the state of my memory in that the name of the member concerned has receded into the most secret canyons of my mind, despite the best efforts of 'find', 'grep' and 'locate' Linux could offer. John Bryant has a 7 1/4 inch gauge locomotive, which detected difficulties on the OVLSME track. This was supposed to conform to international track and wheel standards but he found that they were not universal, even in North America. This detailed examination took six pages (see *the letter on wheel profiles in this month's Post Bag* - Ed). www.ovlsme.com.

On Track from **Richmond Hill Live Steamers** begins by publicising another club's event. The Model Railway Club of Toronto is having a Family Day and enthusiasts' gathering, inspired by the Central Ontario Railway. There are several workshop machine tools for sale by members as well as a part completed locomotive. An unusual video mentioned by Grant Will is said to be about Hiroshima tram cars but seems mostly about the days following the dropping of the bomb. www.richmond-hill-live-steamers.tripos.com. **Chesterfield and District Model Engineers Society's**

Stephenson Link opens with a picture of the internal view of Papplewick Pumping Station and a gentleman dressed in Steampunk style and fitting right in. Malcolm High has been fettling *Hady Belle*, including replacing her clack valves with commercial items. A cycle speedometer using GPS has been fitted, bought from a cycle shop. The advantage of this is that it will display the speed over the ground. Brian Eatock writes a piece entitled *Nothing To Do With Model Engineering* which began with a piece of wood. He saw a sign over a shop window having a picture of a hiker in it. Returning home, he obtained a piece of wood with which to carve a similar figure. He then found out he was about to be made redundant. He was quite vexed at this as he was only a month short of a large cash settlement. An interview with a friendly manager released a Myford ML7 into his care in lieu of cash. Subsequent models he made were a Rob Roy, a Black 5 two Minnies, a Lion, a Sweet Pea, a steam launch, a sailing yacht, nine stationary engines, a steam plant and a biplane. By the age of 79 and in poor health, he disposed of most of his workshop, retaining only the Foden steam wagon and the two Minnies... and, of course, the hiker, still unfinished after 41 years on the shelf. Brian estimates that of all his skills, the carved hiker took the most, **photo 4**. Pete Nash writes on the preservation of Hudswell Clark No. 573 of 1902, Handyman. www.cdmes.co.uk.

Speaking of Steampunk, I have discovered a series of enhanced AI videos on YouTube under the heading of Science Fiction. These involve stunningly detailed images of a Steampunk world incorporating cars, railways, aircraft, dinosaurs and buildings floating in the air. Try to disregard the steam locomotives where the valve gear appears unconnected to the driving wheels, and the electric locomotives with pantographs raised but no catenary. Some of the cars bear a distinct resemblance to the Bugatti Veyron.

Inside Motion from **Tyneside Society of Model & Experimental Engineers** has Peter Newby writing on portable engines. These were very popular at the time but were lightly constructed. The makers were building six portables for every traction engine. Marshall made 100,000 and Garrett, 33,000. The machines were often neglected and few now survive. I was doubtful as to these numbers, but one machine built in 1916 was numbered in the 70,000 range. www.tsme.co.uk.

And finally, a recent report tells us that 80% of British people are cremated after death. That makes it kind of hard on the other 20%. ●

Photo 105: A set of expansion links.



The BR Standard 2-6-0 Class 4 Tender Engine

PART 14

Doug Hewson continues his design looking at the valve gear expansion links. A standardized version of the LMS Ivatt-designed Class 4 loco, 155 of these locos, known as Moguls, were built for British Rail.

We now come on to the expansion links, **fig. 48** and **photo 105**, but once again these came with my pack of valve gear from Mike Jack. I had to drill all the oil holes again and make the oil pots. The holes for fixing the two parts together were drilled before the curved slots were machined. The return cranks, **fig. 49**, and the union links, **fig. 50**, were also supplied by Mike and these are shown in **photos 106** and **107**.

I then made the pair of yokes, **fig. 51**, for the valve rods. They were cut out of a piece of 1/2 inch square BMS bar and I cut the slot first. The bar needs to be slimmed down to 7/16 inch, either on the milling machine or using the vertical slide, **photo 108**. I then used a pair of filing buttons to round off one end, **photo 109**. Before you do this, it

would be as well if you were to drill the hole for the taper pin at the set angle first as this needs to be drilled before the main pin hole is drilled. Then, ream the hole with a taper pin reamer. Now, just pop the taper pin into its hole and trim it to length. You will also need to make a somewhat larger, flat, tapered pin to fix the yoke to the valve rod. The photos show my efforts at making these yokes.

VALVE GUIDES

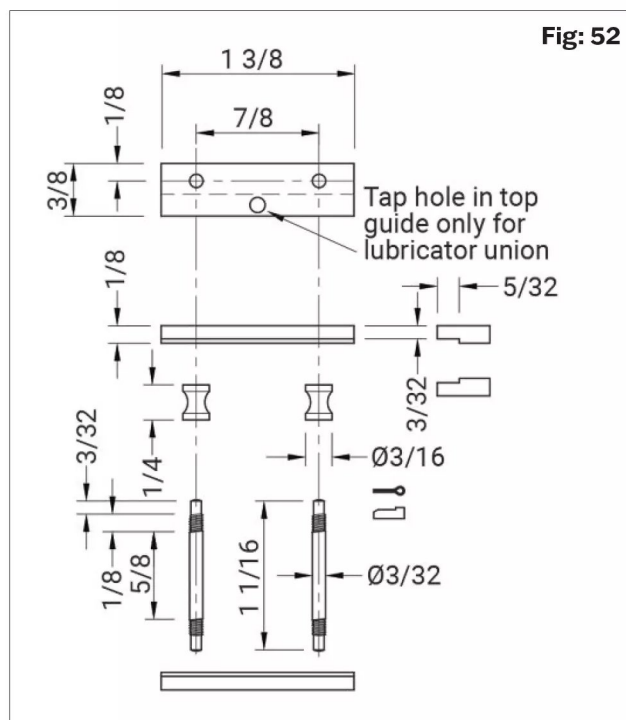
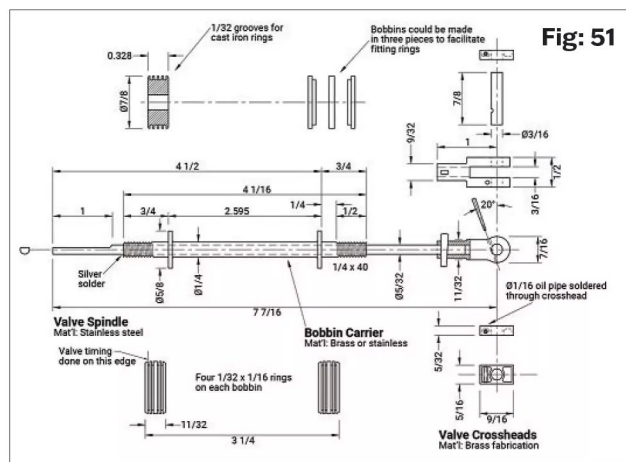
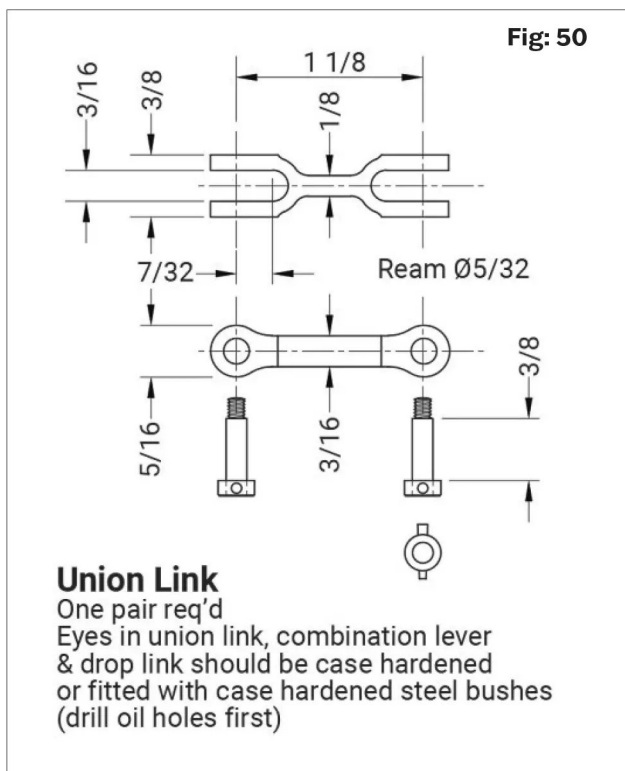
We now come on the making and fitting the valve guides, **fig. 52**, so you will need to get used to some close work, but I am sure you will enjoy it if you aim to make a decent job of it. The actual guides are made from 3/8 x 1/8 inch BMS bar by 1 3/8 inch long. You just need to take a slice off one side

Photo 106: Return cranks.



Photo 107: Union links.





of each bar 5/32 x 1/32 inch and make sure you give them a bit of a polish, not to make them shiny or anything like that but they do need to be a good finish. **Photograph 110** shows mine fixed on my 4MT. Remember to tap the 6BA holes for the lubricator pipes and these are fed from the right-hand lubricator, as are the slide bars. You can see this nicely in **photo 111**. You will also see my stampings (if anyone steals my beloved 4MT they will have to replace all these). They stand for 'Left Outer Upper' and 'Left Outer Lower'.

Now, this is where the close work comes in as you will need to make all the pillars which hold everything together. They are all made from good old 3/32 inch welding rod and they are threaded 7BA - but then the tricky bit comes in. You need to drill a couple of

No. 54 holes through the centre, 1/8 inch apart, and then make the two holes into a slot about 30 thou wide so that you can lock them with split cotters. I made my cotters from a very expensive piece of 12 thou tinplate as can be seen in **photo 112**. You can also see them in **photo 113**.

Last of all, I made my die blocks from $\frac{1}{4} \times \frac{1}{8}$ inch brass bar, **photo 114**. I had to mill out the insides of the guides using an $\frac{1}{8}$ inch ball nosed slot drill and then put the centre piece in later. I then had to fit a little $\frac{1}{16}$ inch oil pipe through one end of the die block so that oil will get down to the bottom slide. At the same time I silver soldered a round bar down through the centre of the die block, flush with both sides, for the lower pin at the top of the combination lever.

To be continued.



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All laser cut parts for Gerald Martyn's "1366" design as featured in this magazine.

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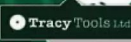


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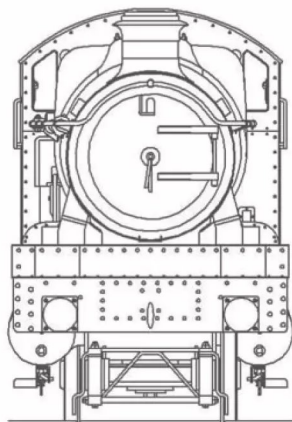


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