TIN PLATING IN THE WORKSHOP ● MYFORD LATHE RENOVATION

THE MAGAZINE FOR MODEL ENGINEERS

ENGINEERING in Miniature

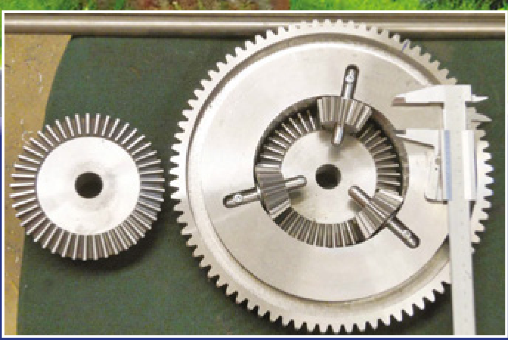
JANUARY 2022 | £4.50

Patience rewarded

Completing a 27-year-old project

STEAM ON THE FARM – ESSENTIAL POWER

Sorting safety valve issues



MACHINING THE GEARS FOR THE 3-INCH TRACTION ENGINE PROJECT

CONTENTS

JANUARY 2022 Volume 43 Number 07

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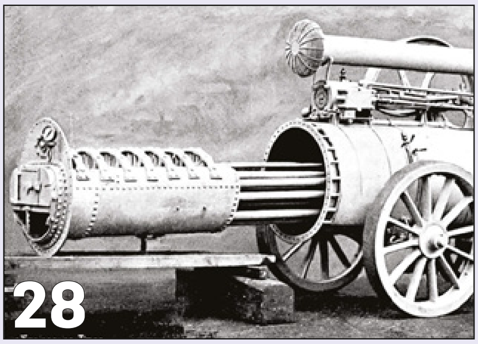

FRONT COVER

Smiles aplenty as Sussex Miniature Locomotive Society member Andrew Brock takes visitors for a ride behind his 5-inch gauge Railmotor, Andrew's first project started in 1994 and as he describes this month, recently completed!
Photo: Andrew Brock

EDITORIAL

New year, new hope?

Welcome to the January edition of EIM and I'll start by repeating my salutations of the season for all those who buy their issue promptly on publication and are therefore reading this more than a week before the big day...

I had intended to be all upbeat this month and look forward to a 2022 where we really get back to something like normality, though as I write these words at the end of November all panic seems to be breaking loose again due to something called Omicron. However if you delve more deeply and beleive what you read in the news media there does seem to be serious hopes that this will not be a repeat of last winter, merely a hiccup on the road to rercovery – let's hope so.

So it's a new year, and one thinks about resolutions – at least I do in the sure and secure knowledge that little of what I promise myself will likely come to pass... Top of the list this year will be spending more time in the Fairbourne Railway workshop, which is a hugely enjoyable way to get a miniature (ish) engineering fix when one's own workshop is not available. Last time I was out on the somewhat chilly mid-Wales coast Tech ed Harry let me loose with of all things a pressure washer! Why? this issue reveals all...

Very top of my resolution list this year, however, will be to finally clear all the detritus resulting from my garage workshop being used as a dump for fmaily furniture and the like, so that I can start making some serious swarf at home! Laying out the features in the magazine each month does leave one envious of those who can simply turn on the light in their workshop and get stuck into their latest project. I'm determined that by Spring I'll be machining up the Stuart 10V I was given a long time ago, just to get into the swing of things, and then starting on something a little more ambitious.

So, what about you? Do you have a list of model engineering aims for 2022? If so could I be cheeky and add a couple more? Firstly, please tell your friends about EIM – those who haven't read us for a while may not realise the variety of proper model engineering subject matter we cover these days, and the more readers we get the eaiser it becomes to maintain that variety. And secondly, how about helping maintain that variety directly, and helping yourself to some of our editorial budget at the same time, by writing something for these pages? The inbox waits expectantly! Have a Happy new Year... **Andrew Charman – Editor**

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Project No.1 – a 5-inch gauge Railmotor

Andrew concludes his description of the lockdown-inspired completion of his first model engineering project, some 15 years after he first steamed it.

BY **ANDREW BROCK** Part Two of two

The date was Friday 20th March 2020 and I had just returned from the last part of a job for Great Western Railway. Fortunately my travels had come to an end just in time and the following Monday our first national lockdown started. I think it is fair to say this came as a shock to many people and aside from finishing the GWR project and undertaking 'daily exercise', I kept myself busy by sorting out the workshop, a job I kept putting off!

Another job I had sidelined was 'Railmotor', which had been my first model engineering project, commenced in 1994, the 5-inch gauge loco first steamed in 2006 with success but also a list of faults to tackle. These were tackled over many years and miles of running (as detailed last month) but the loco never actually completed. But with the workshop sort-out duly complete, I decided now was her time! So in early April 2020, a full strip down of both the engine and tender commenced.

It is not until you take everything apart on a locomotive that you realise how many pieces there are and how many you must have made over the years (Photo 9)!

The first job was to clean everything that had come off, starting with the basic chassis for both the engine and tender. A process of cleaning with white spirit, Scotchbrite (where required) and finally degreaser was followed, and soon I was ready for the first coats of paint (Photo 10). I had most of the paint in stock and used Bilt Hamber EtchWeld from a spray can for the primer, followed by ACE Coatings semi-gloss black and Precision Paints semi-gloss Buffer Beam red for the two chassis, both of which were brush finished.

Tracing leaks

In between painting, I also started to dismantle the boiler ready for a closer inspection of a leaking superheater tube. A hydraulic test at home found the exact spot on the front tubeplate and in addition two beading stays in the firebox, although the latter were fairly minor.

The next job was to thoroughly clean the boiler shell (Photo 11) ready for a re-heat and at the same time I made a batch of O-ring seal bungs to make subsequent hydraulic tests much quicker to conduct. With help offered from a local model engineering friend to re-heat the boiler, but with a lockdown still in place, the boiler was placed on the shelf for the next few weeks until it was deemed safe enough to meet with people once more.

In the meantime it was back to painting and by now most of the tender chassis was complete, so attention turned to the tender body and then to the locomotive cab, lagging and chimney/smokebox, almost all of which were brass.

Although cleaned after the loco's last run, time had not been kind to the brass and each piece took a while to prepare for etch priming. While I was still some way off applying the top coats of paint, I decided to etch prime now, so as to give this base coat plenty of time to 'etch' before starting on the upper coats.

A couple of days later and with several blisters on the hands, the brass was clean and ready to be sprayed.

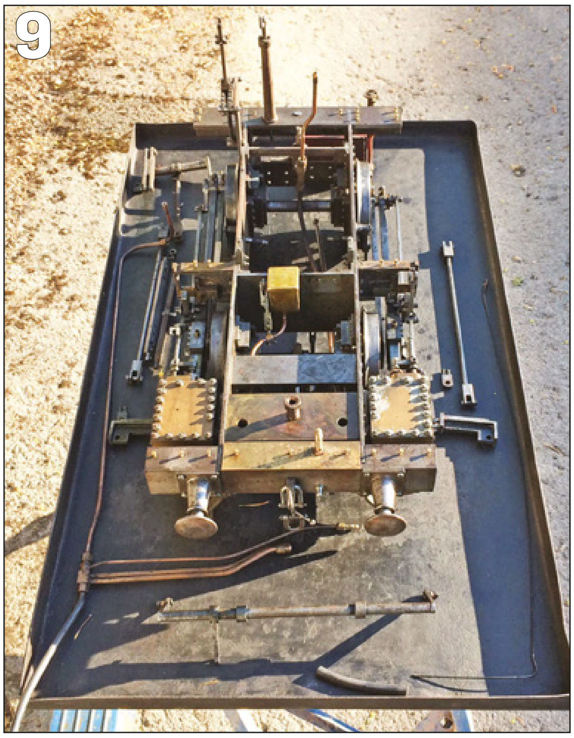


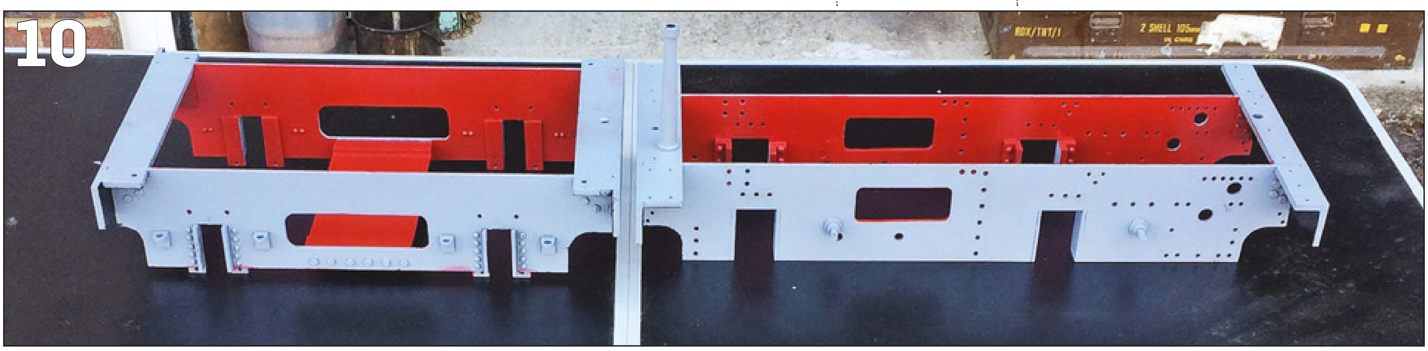
PHOTO 9: The first phase of disassembly for cleaning and painting.

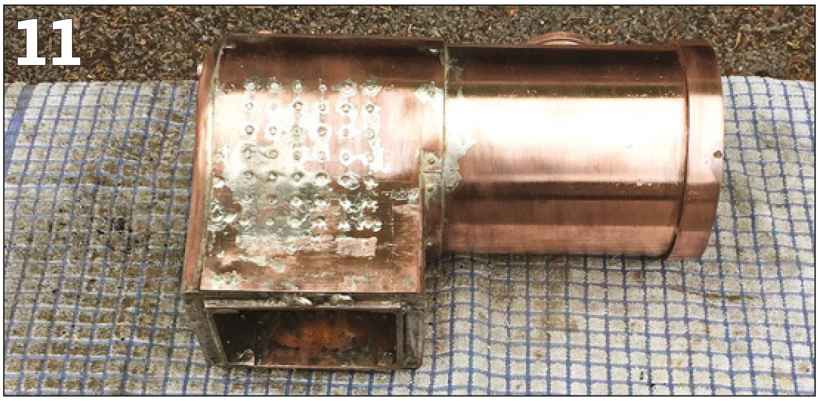
PHOTO 10: The chassis receives its first coats of paint.

All photos by the author

Everything went well, except for one side of the tender body, which developed a paint run (also known as an operator error) so this whole side was stripped back with thinners. A second attempt with the etch was successful and all the brass parts could be put to one side for when their time for top coating was due.

By mid-June restrictions had eased sufficiently, so the boiler underwent its repair. A combination of propane and oxy-acetylene torches were used with the propane a pre and background heat (Photo 12), and the oxy-acetylene for the close-in silver soldering with sulphuric acid baths





and hydraulic tests after each attempt.

Having silver soldered several new boilers and knowing their vagaries even when clean, I was unsure how a repair to a relatively 'dirty' boiler would go. Two days and several heats later I had my answer – not that easily! It was not so much the repair that caused the problem, that joint went well; it was the other small leaks that we chased, particularly inside the firebox. In the end, an executive decision was made not to spare the solder but to basically 'tin' or in this case 'silver' as much of the rear tube plate as possible using the 'Easi-Flo 2'!

Barring a couple of beads which I am more than happy to live with, we got there. It was an interesting experience and one which I am pleased came out positively. My enthusiasm is normally pretty high but the thought of a new boiler at this stage may have tipped the balance!

With the boiler back home, a final shell test was undertaken and once satisfied all was well (Photo 13), I could now look at mounting the boiler fittings in between other jobs.

Starting the rebuild

To maximise enthusiasm, I decided in the short-term to put the boiler to one side and concentrate on rebuilding the locomotive chassis back to an air-running state. When originally dismantled, I had left as much of the chassis together as possible, and connected to the cylinders, in order to keep as many of the parts in one piece (Photo 14).

Now with a need to paint the wheels and cylinders, I removed what was necessary to extract the wheel sets but left most of the motion attached to the cylinders. This motion was then wrapped in newspaper to protect it from the etch primer.

With the wheels free, I spent a day pinning them to the axles, which had not been done originally. There was no sign the Loctite 648 had loosened in any way, but this was my only real opportunity to add a 6BA grub screw for extra strength!

Complete and thankfully with no broken taps, the wheels were cleaned, axleboxes and crank pins wrapped in newspaper and etch primer applied. The cylinders followed and the paint on these items was left to harden in the summer sunshine.

I had for many years talked about painting Railmotor in 'photographic grey' and in fact there is a very nice photo of LSWR No. 101 at Eastleigh in said livery. However, a spare can of ACE Coatings 'light olive' green was kicking about from Andrew Strongitharm's 'Dougal' project that was serialised in EIM, so that would be my colour. It was even better since the can was a 'freebie' from ACE because the mix was not quite right for Dougal.

The paint was always mixed nine parts paint to one part W219 thinners or in my case weighed 9ml to 1ml in a small 1oz jam jar. This consistency was best used in the first couple of days, thereafter the wet-edge time was reduced and the paint less easy to work with, although the wheels being of a small surface area posed no real problems for me.

The brushes used were all Daler-Rowney D88 Flats and of varying widths depending on the surface. These are a good 'all-rounder' being moderately expensive but at the same time not a budget brush. If cleaned and kept properly I have found them to be excellent and give a decent surface finish.

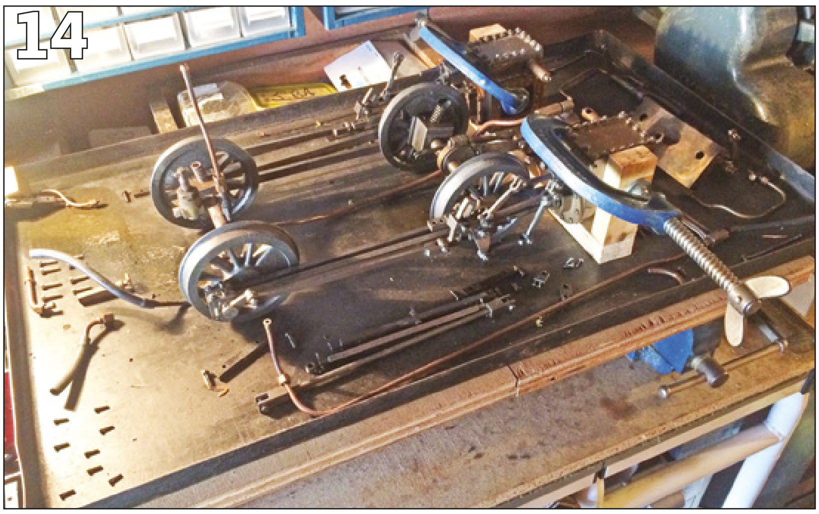
With the cylinders and wheels top-coat painted, except for the outside cylinder lagging, which was still in primer, another couple of days ▶

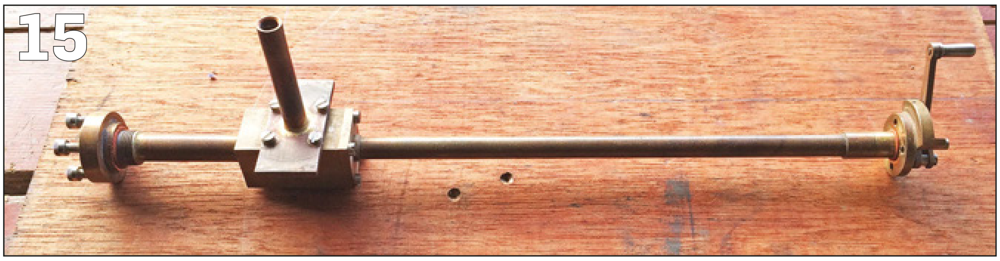
PHOTO 11: Shiny copper – cleaning of the boiler shell in progress.

PHOTO 12: Pre-heating for boiler repairs.

PHOTO 13: Post-repair hydraulic test.

PHOTO 14: Cylinders and wheels ready for disassembly before painting.





were spent resurrecting the chassis. This had to be done as carefully as possible to avoid scratching the paint (basically unavoidable) and was a memory test from when the locomotive was built. Luckily everything fitted as before and methodically I went round and thread-locked (using Loctite 271) all the stainless steel chassis bolts where it was necessary.

With the rolling chassis complete, I turned my attention to the valve gear which had endured 15 years of abuse! Generally speaking it was in pretty good shape but new PB102 bronze bushes and silver-steel fitted pins were made for the eccentric rods, lifting arms and union links to tighten these joints, as well as remedial work to the reach rod arm on the weighshaft. This was drawn with a taper pin to hold it to the weighshaft, but over time the pin had worn in the shaft resulting in lost motion from the reverser stand to the lifting arms.

The problem was remedied by silver soldering the arm to the weighshaft, whilst at the same time being careful not to disturb the lifting arms already silver soldered in place (easier said than done). Fortunately this was successful after another re-heat and completed the jigsaw of the chassis.

"With the rolling chassis complete, I turned my attention to the valve gear which had endured 15 years of abuse..."

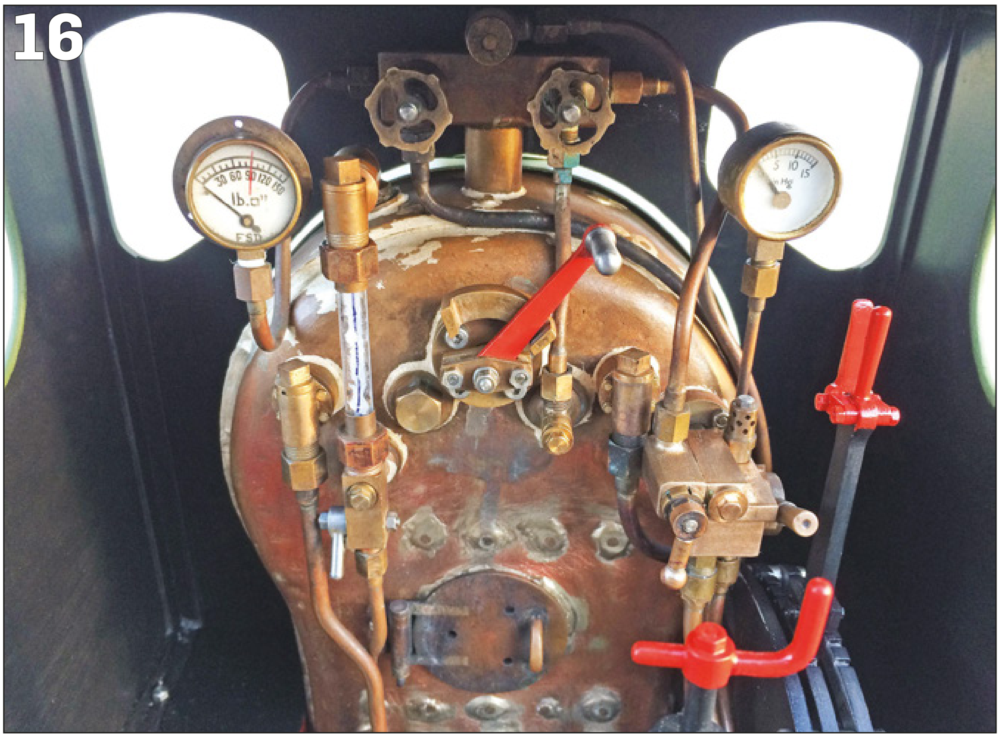
Subsequent air tests proved the chassis was as good as before and it was like the clock had rolled back about 20 years to when the loco's first air test was undertaken in the club workshop – a very happy memory!

With the chassis largely complete, save for some touch-up painting, it was now time to dust off the boiler and fittings... I had already decided the majority of the fittings would remain as is, however a new regulator would be made and the backhead clacks, vacuum-brake valve and gauge-glass blowdown would be altered. In the case of the latter three items this was to bring them closer to the backhead.

The original regulator was a 'Stroudley' disc as per Don Young's drawings but rather stiff to operate and difficult to seal; the new one was a rotating PB102 bronze drum with a PTFE insert (**Photo 15**). This design was similar to that drawn up for Andrew Strongitharm's Dougal and was also the test-bed for the one we used in Sam Ridley's 14xx. All three appear to work well and will hopefully stand the test of time.

Next to tackle was the brake valve; I enlarged the exhaust pipe which runs through the boiler, so it was ¼-inch x 18swg rather than the previous 7⁄32-inch x 18swg. I hoped the extra volume through the bore would mean the ejector could be operated more efficiently and use less steam. At the same time, I moved the body of the brake valve closer to the flange fitting by about ⅛-inch.

Changing the exhaust pipe meant making three new fittings in the smokebox too, which took another couple of days to fabricate from PB102 bronze. Like the brake valve, the clacks were also moved closer to the backhead, the right-hand side one becoming a necessity because the brake valve now fouled on it otherwise! At the same time I added a couple of false flanges behind the clacks to make it look like they are fixed to the backhead by means of studs, rather than screwed into the bush as is the case.



Blowdown replacement

With these fitted, the last job was a revised gauge-glass blowdown. The original protruded a long way into the cab, so I redesigned the bottom fitting to contain a traditional ¼-turn valve rather than the previous screw-down valve. I salvaged the flanged fitting that screws into the backhead bush and silver soldered this to a piece of 5⁄16-inch square copper. The copper had a top fitting turned and externally threaded 5⁄16-inch x 40tpi for the bottom gauge-glass gland nut. A ¼-inch long section was turned and externally threaded 3⁄16-inch x 40tpi at the bottom of the copper for the blowdown drainpipe.

The valve itself I had decided to make from PTFE with a square drive to which the handle would attach. Firstly, I drilled a 2.2mm hole centrally across the copper, part-way between the boiler bush fitting and the drainpipe fitting. This hole was then counterbored (very carefully) ¼-inch in diameter and by 9⁄32-inch deep. The PTFE would be made a push fit into this counterbore.

With the copper finished, a short end of PTFE was turned to 0.252-inch in diameter and by ¼-inch long. A 2.9mm hole was drilled throughout and the hole broached 3mm square using a file mounted in the tailstock. I am lucky to have an ML7 lathe with one of the old-school three-lever rack-fed tailstocks, which are ideal for doing this.

With the PTFE made, a ¼-inch diameter length of 316 stainless steel was turned down to 0.175-inch (the 'across-sharps' dimension of 3mm square) and by ⅜-inch long. The final 3⁄32-inch of this was turned down further to 0.086-inch and externally threaded 8BA for a stainless locking nut. The stainless was left in the chuck, which was moved to the dividing head for the square faces to be machined.

Once complete, the stainless was cut down to a total ⅝-inch in length and another 8BA thread of ³⁄₃₂-inch in length and square of 3mm A/F by ⅛-inch in length machined onto the other end. This left a ¹⁄₃₂-inch fixed washer of ¼-inch diameter between the square sections, which locates inside the copper body.

The PTFE was then pushed onto the longer square section of stainless and a ¹⁄₁₆-inch cross-hole drilled to match the through hole in the copper body. A stainless steel handle with square drive was added and hey presto, 12 hours or so later the improved valve was finished and 100 per cent sealed, smooth and tested! It does look a lot better and completed the cab fittings (Photo 16).

During the process of remanufacturing the cab fittings, I had been painting the running plates and smokebox using Reeves Smokebox Black and boiler cladding, cab, cylinder cladding and tender body in the aforementioned light olive green. The green had by now about 10 coats, with a quick rub-down using 1200 grit Wet & Dry between coats, and was ready for a final rub-down using 2500 grit Wet & Dry.

With the cladding smooth and the fittings sealed using Loctite 243, the smokebox was added to the boiler and trial fitting to the frames commenced. By luck, the whole assembly fitted much as it came off and only removed a bit of the red frame paint in the process!

A loco again

With the smokebox reattached, another couple of days were spent mounting the boiler/smokebox to the frames, sealing the exhaust/steam pipes in the smokebox and adding the clack, injector and whistle pipes at the cab end. This was a major milestone because Railmotor became recognisable once more, particularly to passing neighbours who suddenly saw her as a steam locomotive and much to the delight of the many children who pass by too...

Before adding the cab and running plates, I undertook several propane-fired steam tests to make sure all the fittings worked. Barring some adjustment to the safety valves, a couple of small leaks and a change of injector, everything did work.

Final assembly was undertaken towards the end of October 2021 and some 18 months after I first started disassembly. As I write this during mid-November, Railmotor is 99.9 per cent complete and ready to hit the rails once again but not before a visit to the village church during an open morning I was asked to display at, which showcases local traditional skills (Photo 17).

A mere 27 years or thereabouts after the first scribe lines were marked, I now have a finished locomotive. It is not 100 per cent perfect, nor in the timescale I ever dreamt of but it is a reality nonetheless (Photo 18). And there is the reality. If you are a young member of a model engineering club and think that building a model seems pretty cool then give it a go. You will need a lot of dedication and help along the way but that dream can become a reality.

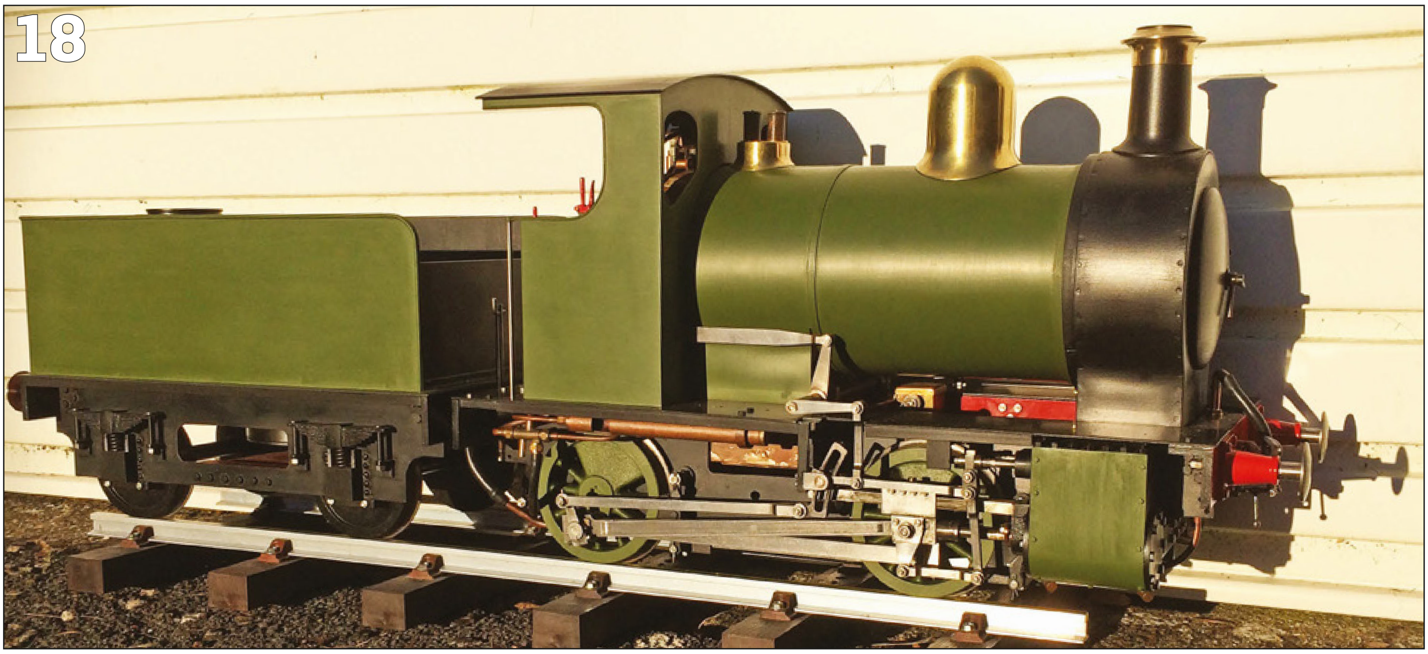
And if you are an older or more experienced model engineer then think about how you can help the next generation to learn the skills you have. After all, Railmotor is me but also those members of Sussex Miniature Locomotive Society who over the years have given me so much of their time to achieve my dream. And thanks to those people I can now pass on my experiences and skills to the next generation, so in turn they can achieve their ambitions – we were all there once... EIM

PHOTO 15: New regulator ready for fitting.

PHOTO 16: Final cab layout after work on several of the controls.

PHOTO 17: Finished loco on display at a local church.

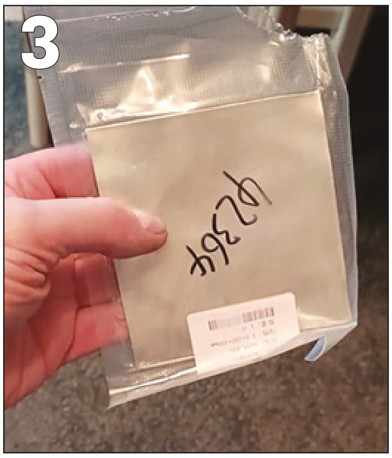
PHOTO 18: The reality, a completed first project outside the workshop.



Tin-plating in the workshop

Rich adds to his recent series on protective plating techniques using chemicals in the workshop, by creating material familiar from period toys...

BY **RICH WIGHTMAN**



HEADING: Showing how protection works on three pieces of cast iron. That on the left has been blackened, the centre tin plated. The untreated sample at right has rusted after a short time in the workshop.

PHOTO 1-3: The ingredients for this experiment – white vinegar, salt and a piece of pure tin.

PHOTO 4: Add around this much salt.

All photos by the author

Is it just me or does everyone else look at everyday objects and think to themselves what could I do with this? Why do we throw so much away? Could I make some use of it?

It was while opening a tin of baked beans that I stood looking at the tin. We don't give much thought to the humble tin can do we, but it was the tin plate that sparked some interest. Tin plate – it's exactly what the name implies, it's what it says on the tin, steel plated with tin.

Now tin is nothing new of course, it's been around for three thousand years or so. The bronze age saw one of the more well-known uses of tin when it was mixed with copper to produce a harder metal. Underground tin mines in Cornwall can be dated as going as far back as the 16th century.

Tin, chemical symbol Sn, sits at number 50 in the periodic table. As a comparison silver sits at number 47. Should you be interested you can find the full table at the following link – www.periodictable.one/elements

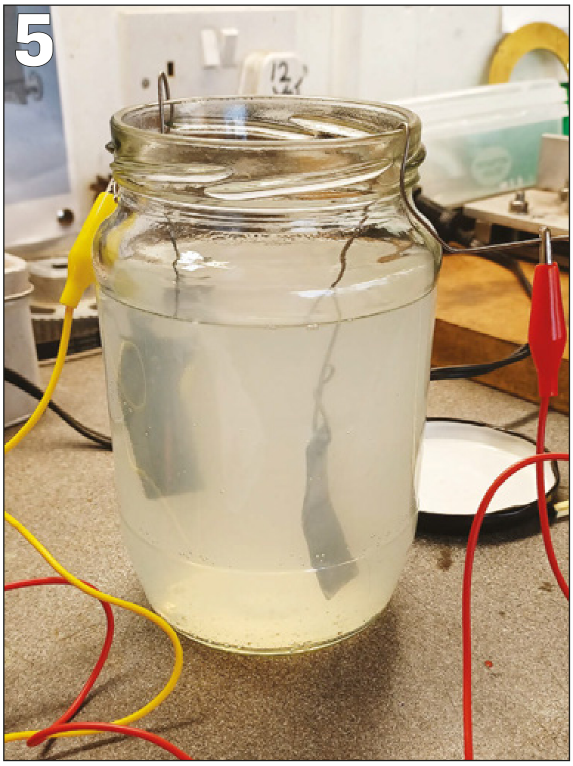
In previous issues of EIM I have detailed my trials with various forms of plating, using zinc, copper and nickel, followed by an article on etching. I use the zinc plating technique a lot in the workshop to protect items from rust, while nickel plating gives a pleasing look to parts.

So I wondered, would it be possible to tin-plate items in the home workshop? After all tin plating has been used for a long while to protect metals from corrosion. This could be very useful as rust is a constant enemy in my workshop.

Chemical deterrent

A bit of research dampened my initial enthusiasm, however, as the tin-plating technique involved the use of hydrochloric acid. I found several other methods but all of them required quite strong acids of one sort or another, which was not what I wanted to use at all so I initially dropped the idea.

It was while having a bit of a clear up in the workshop I came across a bottle of white vinegar (Photo 1) and some salt (Photo 2) left over from my previous plating experiments. I wondered to myself, would it work? I couldn't find any reference to tin plating with vinegar, but surely somebody has tried it?



Curiosity had now got the better of me so I delved into that well-known online auction site and did a search for Tin Anode. Lots of choices came up and I duly purchased a 4-inch square 1mm thick piece of pure tin (Photo 3).

Just before I describe my experiment can I emphasise that when undertaking such techniques, although I am using fairly safe chemicals its always best to wear eye protection, gloves and such like and to observe any warnings/advice on the containers.

A clean pickle jar was requisitioned from the kitchen and filled with white vinegar of 5 per cent acidity. About a teaspoon of salt was added (Photo 4) and stirred until completely mixed.

Two pieces of the tin, about 1½-inch x ½-inch, were cut from the sheet and a 2mm hole drilled in one corner of each piece. I used some titanium wire to suspend them in the liquid, making sure they were not touching and connected a positive lead to one piece and a negative lead to the other (Photo 5).

Visual distraction

The power was turned on and the voltage set to 1.5 volts. After a few seconds the tin attached to the negative lead (the cathode) started to bubble. It was quite mesmerising and I watched it for a while, before deciding to leave it like that for about four hours, after which the solution had turned slightly cloudy.

It was now time for the acid test, if you will pardon the pun, would it work? Yes it did.

"I couldn't find any reference to tin plating with vinegar, but surely somebody has tried it?"

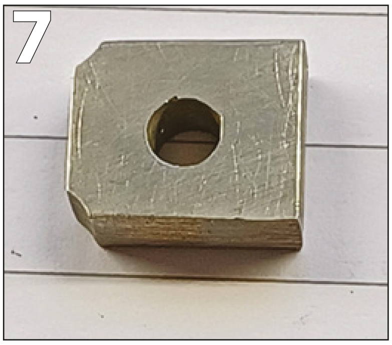
PHOTO 5: Two pieces of tin suspended in the solution.

PHOTO 6: A test piece of scrap brass.

PHOTO 7: The result of tin plating the brass sample.

PHOTO 8: Further tin plating on brass.

PHOTO 9: An aluminium test piece.



I found a small piece of scrap brass and gave it a quick rub over with some emery cloth to clean it up before a piece of titanium wire was attached (Photo 6). The piece of tin was removed from the negative lead and replaced with the brass test piece. The power was turned on again and within a few seconds bubbles appeared around the brass.

I gave it a minute or so and pulled the brass out to check the progress. It looked like it was tin plated already so I stuck it back in for another three minutes, giving it the occasional swirl round – Photo 7 shows the result.

I found another piece of brass strip and plated that (Photo 8). It is also supposedly possible to tin plate aluminium so I tried that – if you look closely at Photo 9 you can just see the lower half has changed colour slightly. It was not easy to tell how successful the process as the untreated and treated halves are of a very similar colour.

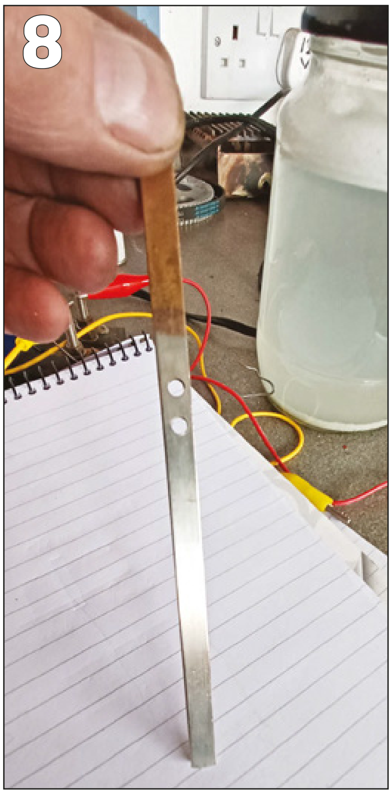
Finally I added a spoonful of sugar – from my previous experiments I knew that sugar is used as a brightener. I carried out a test on three pieces of cast iron, as per the heading photo. The piece on the left has been treated with a metal blacking kit I have, the centre piece has been tin plated and the piece on the right is untreated.

I threw all three pieces in a bucket of water for two hours and then left them out on the bench overnight. The blacked piece and the tin-plated piece have survived well while the untreated piece has clearly rusted.

A short video I made of a test piece fizzing can be seen at https://youtu.be/xS8Xd10XZsM

Well there you have it, tin plating in the home workshop for very little expense and using reasonably safe chemicals – I hope you continue to find my experiments of interest. EIM

■ Rich's previous experiments with plating were described in EIM during 2020, the August issue (zinc), September (nickel) and October (copper), followed by a feature on etching in November. You can download a digital back issue or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.



A freelance traction engine in 3-inch scale

Jan-Eric's latest project, to build a freelance traction engine aimed more at regular use rather than fine prototypical accuracy, this month focuses on the differential drive.

BY **JAN-ERIC NYSTRÖM** Part Five of a series

A traction engine (whether full-size or model, regardless of scale) differs from a locomotive in two important respects: one, it doesn't need a track to run on, and second, it contains a lot of gear wheels! The gears are necessary in order to provide the low speeds and very high torque needed for hauling purposes, while the steam engine itself can still be run at a high speed, necessary for supplying power to other machinery via a belt drive from the engine's flywheel.

I have simplified the design of my own model quite a bit, for instance, I won't have a functioning wire drum which was used for pulling or ploughing purposes, by winding a steel wire onto the drum between the hind wheel and the frame of the engine. In order to retain the typical outline of the engine, I will include a dummy drum, but not the complicated latch mechanism and other details present in the full-size engines – as you all know by now, this model is not intended to be a museum quality miniature, just a fun toy!

Also, I didn't bother to mill the gear wheels myself, even though it might be an interesting project by itself. In particular the bevel gears for the differential drive would take quite some time to design and machine.

A local supplier ordered and obtained all the gears I needed, as can be seen in Photo 52. In the picture they are placed on a drawing of a full-size engine, scaled to the size I'm building, in other words 3-inch to the foot or one fourth of full size.

The same supplier also provided the PTFE-coated, steel bearing bushings seen in the plastic bags at right in the photo. Costing less than £1 apiece, these self-lubricating bearings are ideal for model engineering projects, requiring very little space in the miniature engine.

The pillow block ball bearings seen in the picture were ordered from China via eBay, at a cost only a fraction of what they would be locally. The gears are metric Module 3 – the diameter in millimetres of a wheel is three times the number of teeth. The largest gear has 80 teeth, thus it is 240mm, or almost 10 inches wide over the 'pitch circle', which is measured from halfway down the teeth on both sides of the gear.

Using Imperial measures, gears are usually specified by 'Diametral Pitch' (DP), in other words the number of teeth per inch of the pitch circle diameter. A Module 3 gear thus has an approximate DP of 8. Inch-based DP gears will of course not mesh properly with metric Module gears!

The smallest gears were inexpensive, less than £10 each. The largest, 80-tooth gear cost quite a bit more – it weighs more than 10 kilograms, or 23lbs! However, it was the three pairs of bevel gears that really did set me back a bit. All in all, the total cost for all the gears and bearings was around £500.

Had I milled and turned

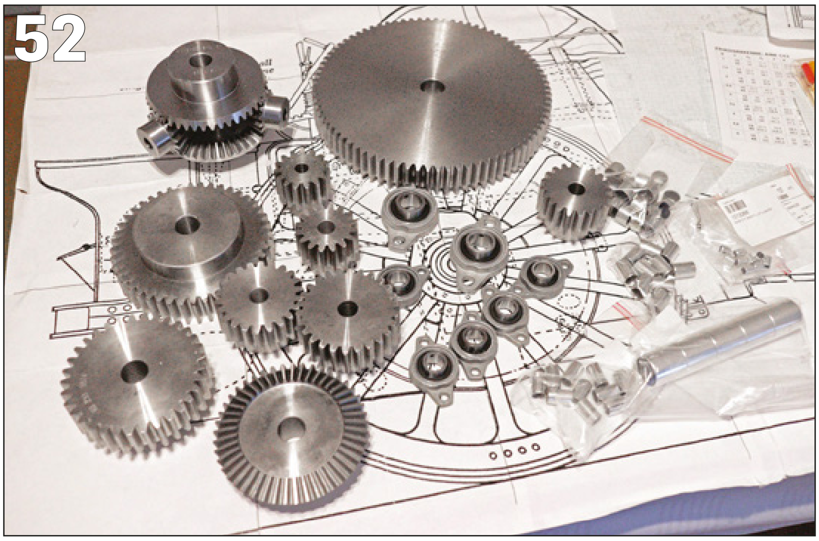


PHOTO 52: All gears and bearings bought in to save time.

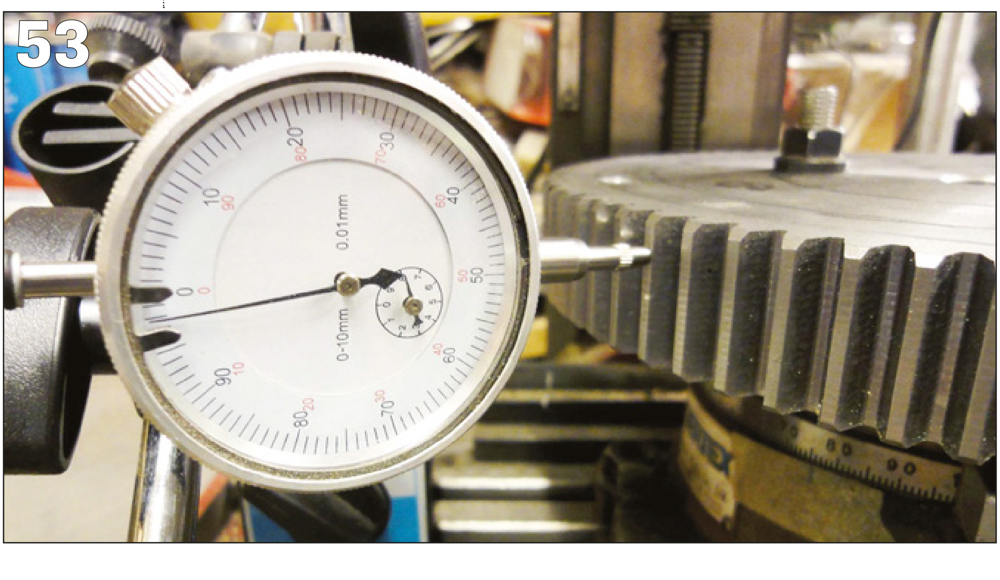


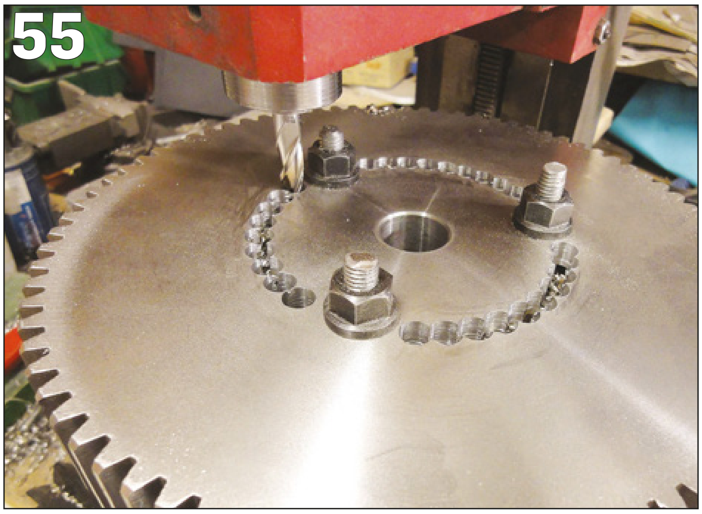
PHOTO 53: Centring the large gear on the rotary table.

PHOTO 54: A deep groove is milled in the large gear – very time consuming!

PHOTO 55: Chain-milling holes to remove central portion of the gear.

All photos by the author

54



55

everything in the gear train myself, I would have spent at least several more weeks, maybe even months, on the project. Some modellers prefer to machine all the details just as they are in the original full-size prototype, but I prefer to simplify, in order to be able to run my engine as soon as possible!

Machining the gears

Even though the gears are store-bought, they all need to be machined in one way or another. For instance, the largest gear will contain a half-inch wide and deep 'brake groove' for the engine's brake shoes – in my design, there won't be room for a proper brake drum, as used on full-sized engines.

Since the 80-tooth gear wouldn't fit in my lathe, I did all the machining on my small table-top vertical mill. Photo 53 shows how I centred the gear on the rotary table on my mill, using a dial indicator. Of course, you cannot rotate the gear and look at the indicator pointer in the way you can when centring a round workpiece in the lathe – instead, I had to pull the indicator's plunger free from the gear every time it was rotated, and I always took measurements from the very tips of the cogs.

With the gear centred to within 0.01mm (less than half a 'thou' in inches), I started milling the brake groove. This had to be done very carefully – my small mill has some backlash and is prone to vibrate if too large feeds are attempted – so I took cuts of only 1⁄16-inch or so, while rotating the table 360 degrees before plunging down another 1⁄16-inch – very time consuming, see Photo 54!

The large gear will also contain the differential gearing, built with the bevel gears. In order to remove the central part of the gear, I chain-milled several holes between the bolts holding the gear to the rotary table (Photo 55). This is much easier than the grooving operation done on the other side of the gear, by just slowly plunging the mill bit into the gear as far as it will go. After that, I could mill away the bridges between the holes (Photo 56).

Proceeding from there, I removed the clamping bolts one at a time, in order to continue milling all the way around. The wheel was thus always held by at least two bolts. However, since this gear wheel is 30mm (almost 1¼-inch) thick, more than the cutting depth of the mill bit, I had to carry out both the chain and final milling one side at a time, flipping the gear over and centring it once more with the dial indicator.

56

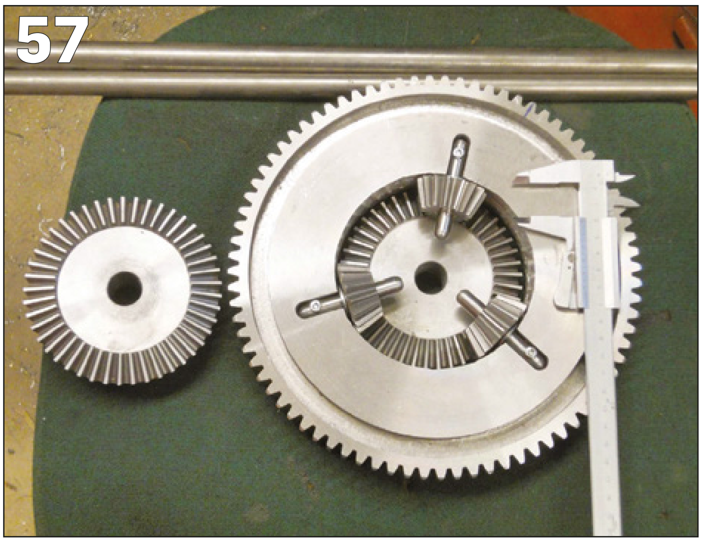
PHOTO 56: Table turned until bolt reached. Bolt removed and put back after milling has passed it.

PHOTO 57: Test assembly of differential gears.

PHOTO 58: Hub secured with roll pins through three pinion axles. Note PTFE bushing in centre of hub.

Finally, I had the central part extracted, and while still having the gear clamped to the rotary table, I could mill three grooves to receive the axles for the bevel gear pinions, at exactly 120 degrees apart (Photo 57). The vernier calliper gives you a visual idea of the size of the gears.

Photo 58 shows a close-up of the construction of the differential's centre, turned down from the extracted part. Note that each one of the three short axles is bolted to the bottom of the groove in the large gear, while the other end is secured to the ►



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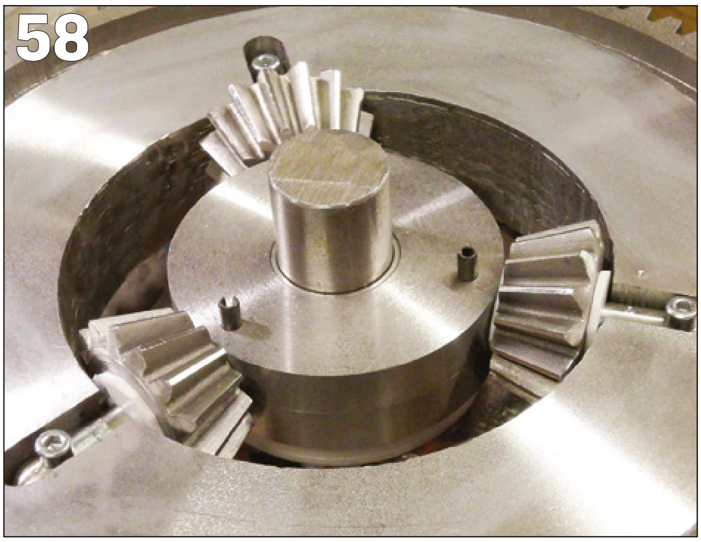

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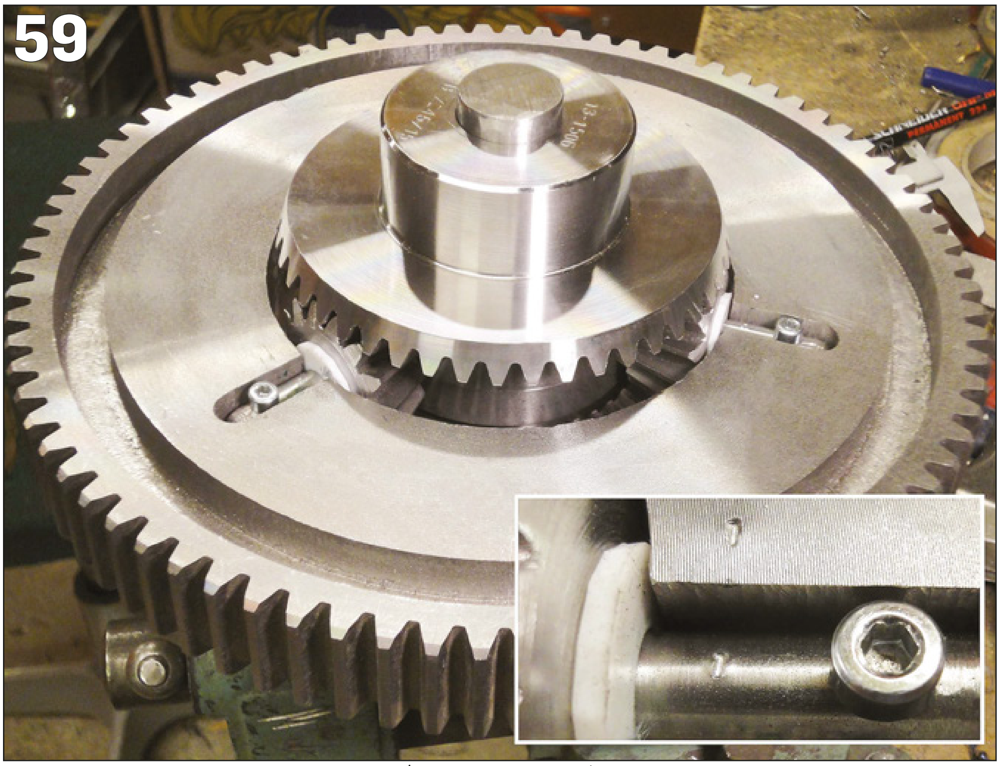


central part with a roll pin, going all the way through. This makes the large gear and the centre rotate in unison. The pinions rotate freely, thanks to PTFE washers on both sides. Note also the thin, PTFE-coated sleeve bearing for the main axle in the centre.

In Photo 59, the second large bevel gear has been placed upon the pinions. Note in the inset that I have stamped a number on each axle as well as on the side of its groove, so that I can re-assemble the differential mechanism correctly, should I ever have to take it apart. Despite the fact that I am trying to be accurate at all times, the admittedly somewhat sloppy tolerances evident in my work does necessitate numbering all the mating parts!

PHOTO 59: Assembled differential. Number stamps ensure correct assembly.

PHOTO 60: Parting off gear wheel slice with angle grinder

PHOTO 61: Parting in three steps; changing worn cutting disk at yellow arrow, using hacksaw beyond the red.

Ear-splitting gear-splitting

All the Module 3 gears are 30mm thick – but for the most part, I needed much thinner ones. I do not like using parting tools on my lathe if the diameter of the workpiece is larger than an inch and in this case, the gear wheels were up to five inches in diameter – that would have required a parting tool at least 2.5 inches long!

Instead, I turned to my trusty angle grinder – as you have noticed in my earlier writings, it is one of my most useful tools but as previously I add a cautionary note on ensuring its safe use. Running the lathe at its lowest speed, I carefully brought the angle grinder's thin, 1mm (0.04-inch) cutting disk to the correct distance from the edge of the gear, and very slowly, taking care to keep it perpendicular, gently pressed it against the gear wheel (Photo 60).

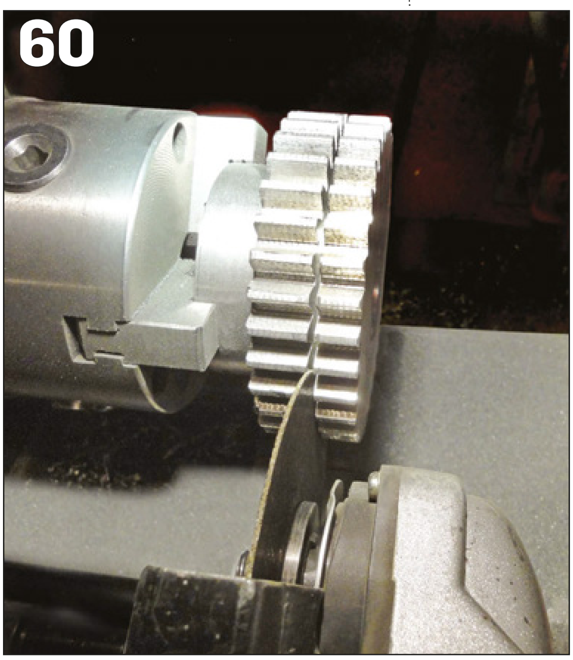
I had of course protected the lathe ways with a piece of tin plate, and **most importantly** had myself donned safety goggles and a face shield as well as ear protection – I don't know if all angle grinders are so incredibly noisy, but mine certainly is! The eye and face protection is absolutely mandatory if you use an angle grinder in this way. Without a shield I would probably have been blinded by flying shards in case of a cutting wheel breaking. Even just the sparks and grit flying around are a danger, so be warned before contemplating using my methods.

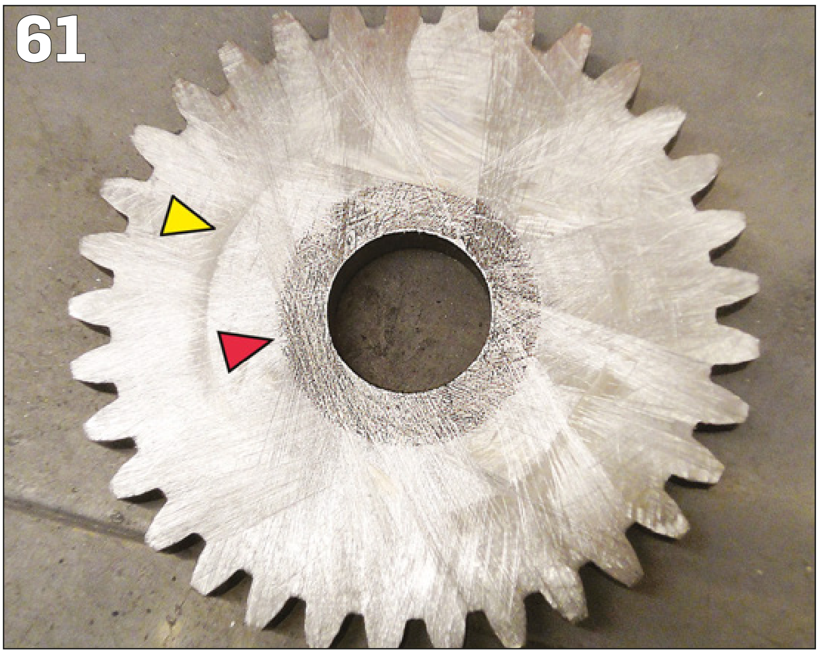
Cutting into the gear proceeded briskly, but if I pressed too hard (something I learned not to do on the very first try), the cutting disk wore very quickly, and caused a stream of grit flying around.

Photo 61 shows how the cut proceeded; the yellow arrow points to how deep I was able to reach with the first, worn disk. The red arrow shows the depth reached with a new disk that had not worn perceptibly smaller as I reached that depth. However, the large hub of the angle grinder prevented me from cutting any further, so the innermost part beyond the red arrow had to be cut with a hacksaw – you can clearly see the saw marks. **EIM**

NEXT MONTH: Jan-Eric tackles vital parts of the traction engine's drivetrain – the crankshaft and dual-speed gearing.

■ Parts one to four of this series appeared in the September to December 2021 issues of EIM – you can download digital back issues or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.



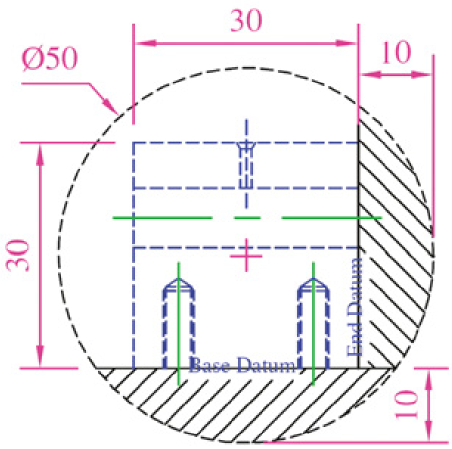


A Feed Pump and Double-Clack for the EIM Steam Plant

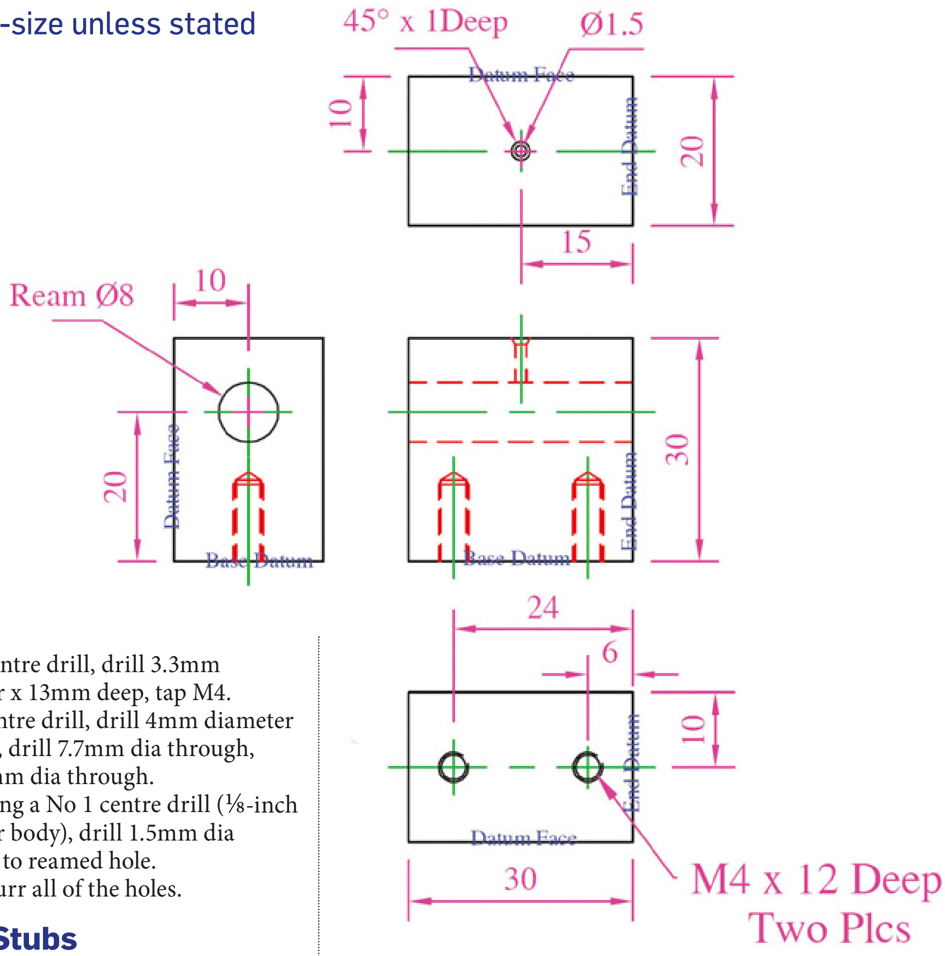
Martin continues construction of an addition to his popular stationary engine build project, this month tackling the valve itself.

BY **MARTIN GEARING** Part Two of a short series

All drawings reproduced approx full-size unless stated



DRAWING FP2
Bearing block



DRAWING FP2A
Bearing block, machining guide

Last month we began our project to provide the EIM steam plant and its boiler, the construction of which had been previously serialised in this magazine, with a powered feed pump, and we initially built the base – now it is time to start on the components of the pump itself.

The Bearing Block

Item FP2 - 30 x 30 x 20mm cast iron. Refer to Drawing FP2 - 2A.

Referring to Drawing FP2, machine the blank to size from a 25mm length of 50mm Concast, removing the lower shaded (10mm) portion first, followed by the second shaded (10mm) portion square with the first to provide the initial datums – mark the datums with a felt-tip pen. Working from Drawing FP2A machine the piece as follows;-

Base: Centre drill, drill 3.3mm diameter x 13mm deep, tap M4.
End: Centre drill, drill 4mm diameter through, drill 7.7mm dia through, ream 8mm dia through.
Top: Using a No 1 centre drill (⅛-inch diameter body), drill 1.5mm dia through to reamed hole.
Deburr all of the holes.

Pipe Stubs

Item FP3 – ¼-inch diameter brass. (Three required). Refer to Drawing FP3.

In the lathe, hold the stock with 15mm protruding and face-off. Turn 6.35mm diameter x 13mm long and thread ¼-inch x 32 ME x 8mm long.

Using a No 3 centre drill (¼-inch diameter body), go in until the 60-degree surface leaves a just discernible trace of the end face. Drill 2.5mm diameter x 11mm deep.

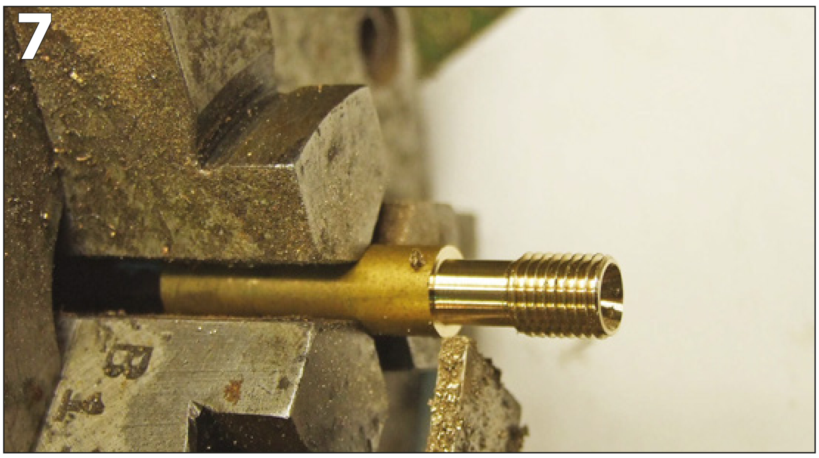
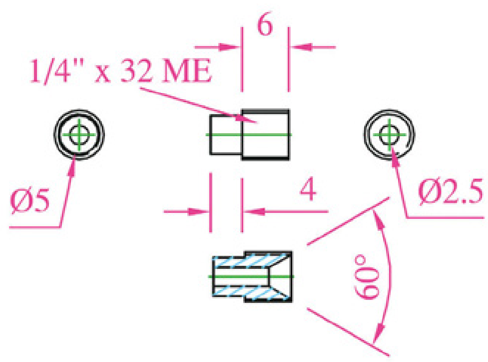
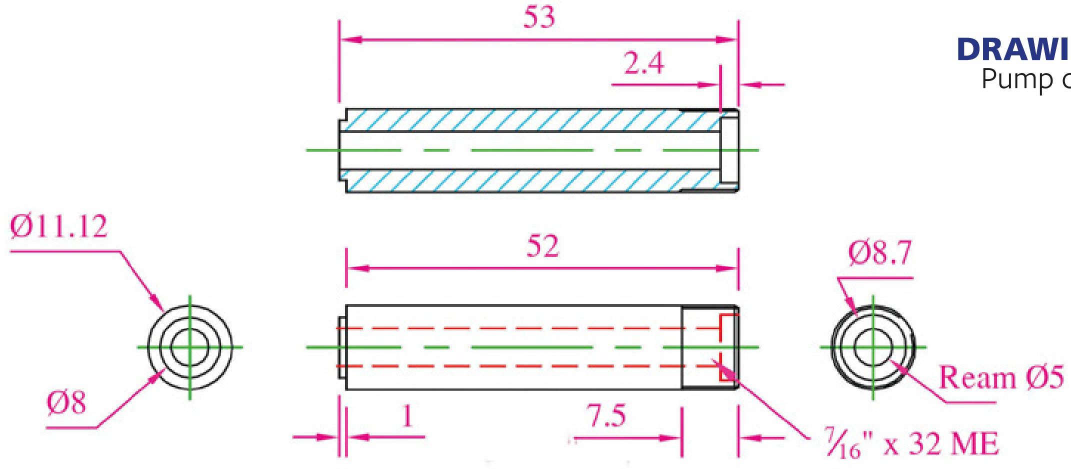


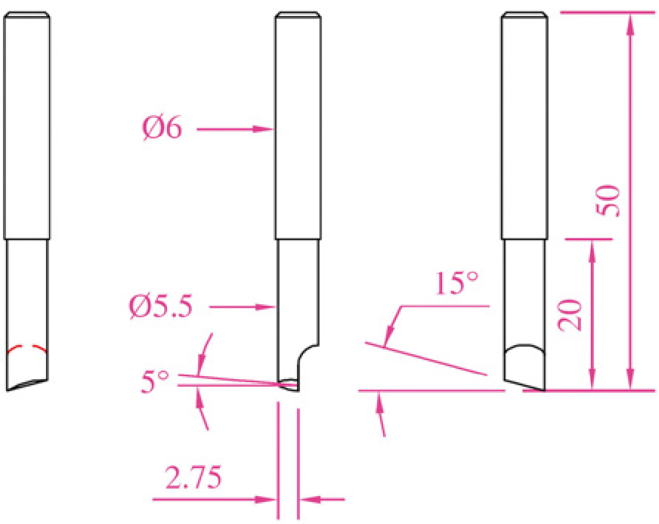
PHOTO 7: Thread turned on pipe stub.



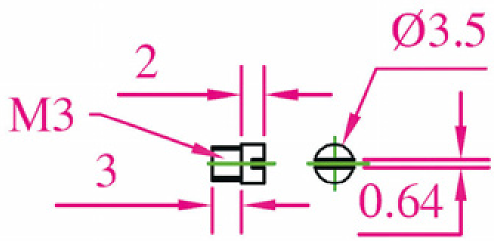
DRAWING FP3
Pipe stubs



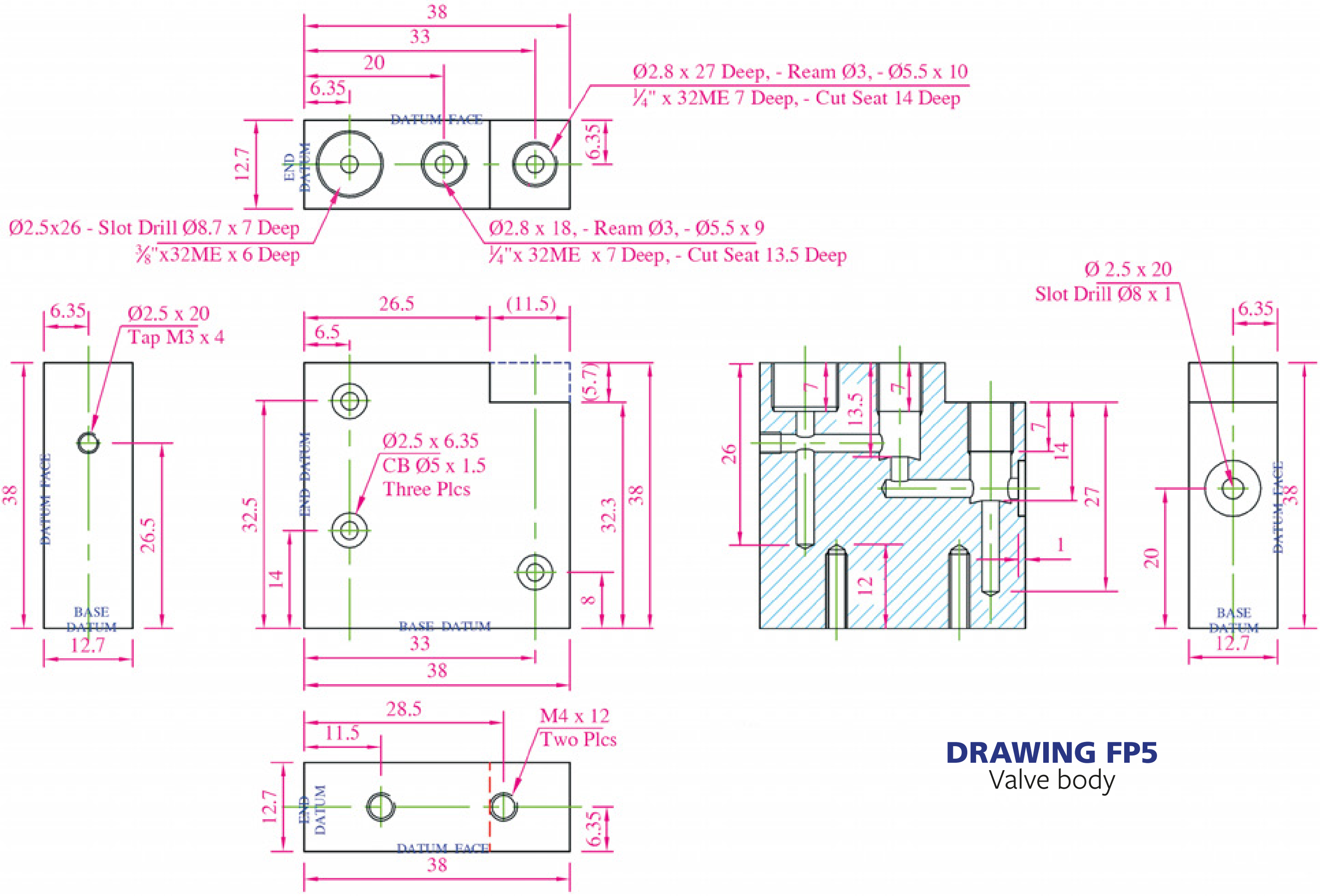
DRAWING FP4
Pump cylinder



◀ DRAWING FP5A
Valve seat D-bit



DRAWING FP6
Drilling blank
(reproduced 1.5 times full size)



DRAWING FP5
Valve body

Using a parting tool turn 5mm diameter x 7mm long so as to leave 6mm length of thread (Photo 7). Part off 10mm long. Repeat the entire process a further two times.

Pump Cylinder

Item FP4 - 12mm or 7/16-inch diameter brass. Refer to Drawing FP4.

Hold the piece with 60mm protruding, face off and turn 11.12mm diameter x 55mm if using 12mm diameter stock.

Thread 7/16 x 32 ME for 7.5mm length. Centre drill, then drill 4.8mm diameter x 55mm length and ream 5mm diameter x 55mm length.

Adjust a 0-25mm micrometer to read 8.7mm and clamp the spindle. Set the 'inside nibs' on a digital caliper against the 8.7mm pre-set faces of the micrometer, rotating the caliper to get the minimum reading before zeroing the display (Photo 8).

Use the caliper as a gauge to measure progress as you bore 8.7mm diameter x 2.4mm for the O-ring cavity, stopping when the display reads zero (Photo 9). Part off 53mm long, face off and turn an 8mm diameter x 1mm long spigot (Photo 10).

Valve Body

Item FP5 - 38 x 38 x 12.7mm (1/2-inch) Brass. Refer to Drawing FP5, 5A, 5B.

The final machining of the valve block involves cutting the ball-valve seats after the three stubs and pump cylinder have been attached by silver soldering. This is so as to ensure that no damage is inflicted on these two critical areas when subjected to the heating required, and upon which the success of the pump's operation will depend.

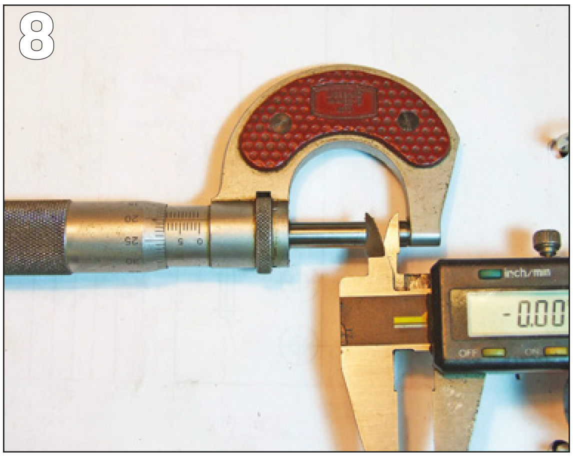
To that end I have included the dimensions in Drawing FP5A of a suitably profiled seat cutter in the form of a D-bit, which can be easily made in the four following steps.

Hold a 50mm long length of silver steel (6mm or 8mm diameter available from crankshaft stock) with 25mm protruding in a true-running chuck. Face off then turn 5.5mm diameter x 20mm long.

Hold the cutter blank horizontally in the milling machine vice with the turned section protruding from the jaws. Using a sharp cutter, taking light cuts, mill away half the diameter to measure 2.75mm (Photo 11).

With a fine file bring the end surface to the compound angles as indicated on the drawing, going over the two surfaces again with a fine oil stone to remove any remaining file marks (Photo 12).

Ideally, transfer to a drilling machine, gripping the drill blank in the chuck with the profiled end facing down, above a container of cold, clean ▶



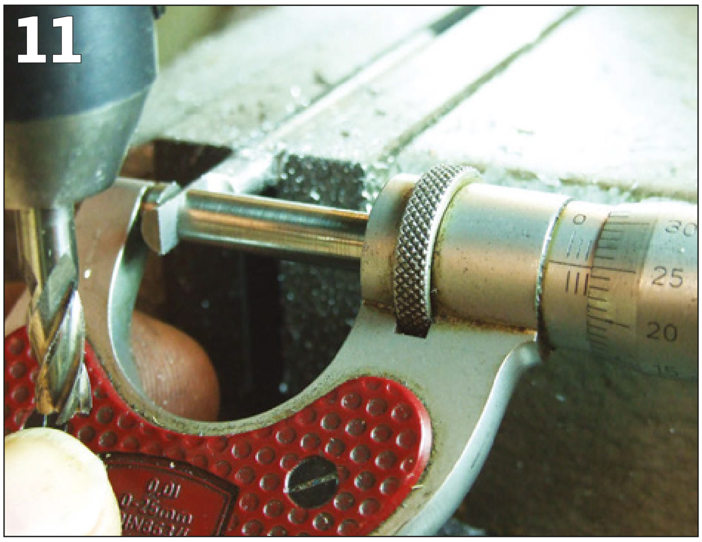


PHOTO 8: Setting digital caliper to produce inside bore of the pump cylinder.

PHOTO 9: Caliper used to provide gauge when boring inner cavity for O-ring.

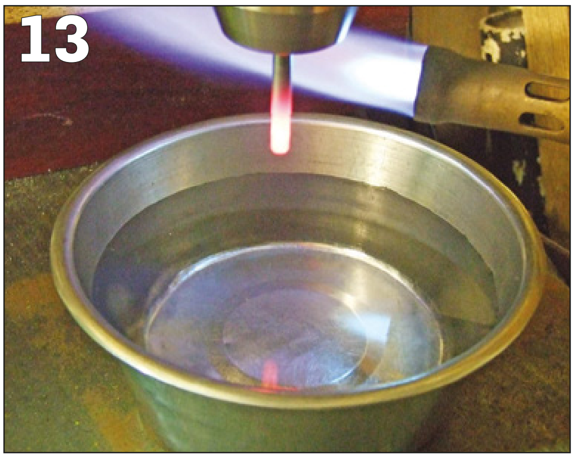
PHOTO 10: Spigot turned on end of pump cylinder.

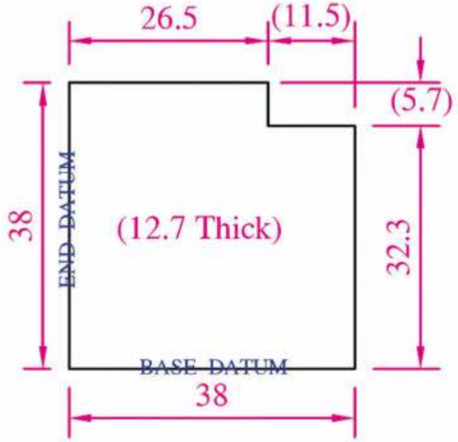
PHOTO 11: Milling away half a piece of silver steel to produce a seat cutter for the valve body.

PHOTO 12: Milling complete on the seat cutter prior to hardening process being applied.

PHOTO 13: First stage of hardening involves heating to and holding at cherry red before lowering into water.

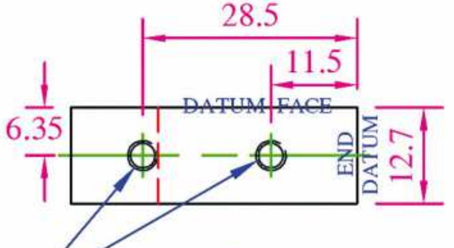
All photos and drawings by the author





Prepare Valve Body Blank - Op 1

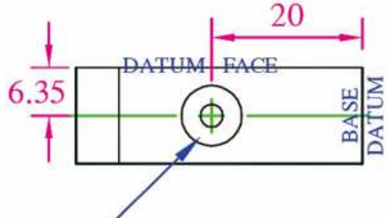
1. Machine to 38 x 38 x 12.7
2. Machine 11.5 x 5.7 "Cut Out"
3. Mark Datums



Base
Mounting Threads - Op 2

At two locations indicated:-

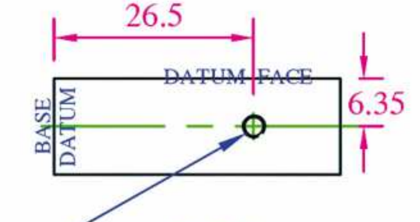
1. Ctr Drill
2. Drill Ø3.3 x 12 Deep
3. Tap M4



Cylinder End Face
Machine Location Register - Op 3

At location indicated:-

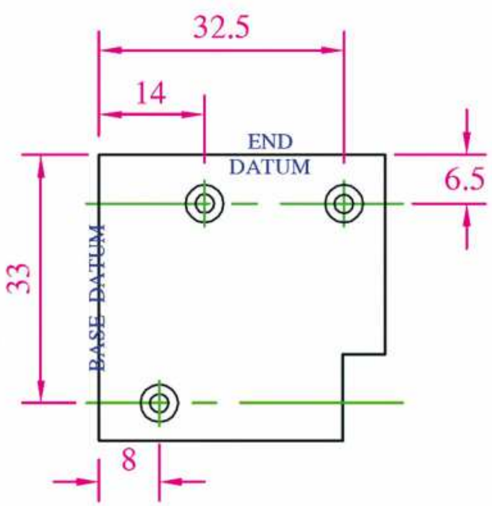
1. Ctr Drill
2. Drill Ø2.5 x 20 Deep
3. Drill Ø8 x 1 Deep with Slot Drill



End Face
Drilling (Plug) - Op 4

At location indicated:-

1. Ctr Drill
2. Drill Ø2.5 x 20 Deep
3. Tap M3 x 4 Deep



Pipe Connection Face
Machine 3 Pipe Stub Seats - Op 5

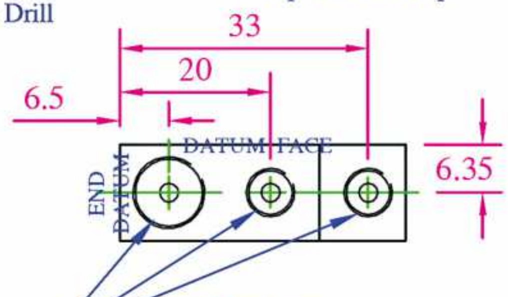
At three locations indicated:-

1. Ctr Drill
2. Drill Ø2.5 x 6.35 Deep
3. Drill Ø5 x 1.5 deep with Slot Drill

Valve Body Sub Assembly
Silver Soldering - Op 6

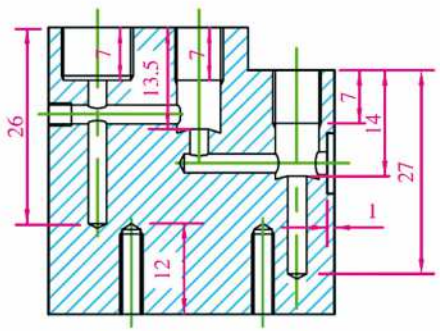
On Pipe Connection Face:-

1. Silver Solder 3 Pipe Stubs to Body On Cylinder End Face
2. Silver Solder Cylinder to Body



Top Face
Machine Three Valve Seats - Op 7

1. Ctr Drill at three locations indicated
2. **At 6.5 on CL**, Drill Ø2.5 x 26 Deep from top face
3. Drill Ø8 x 7 deep with Slot Drill
4. Bore Ø8.7 (Slot Drill $^{11}/_{32}$") x 7 Deep
5. Tap $^{3}/_{8}$" x 32 ME - 6 Deep
6. **At 20 on CL**, Drill Ø2.8 x 18 Deep from Face
7. Ream Ø3.
8. Drill Ø5.5 x 10 Deep
9. Tap $^{1}/_{4}$" x 32ME - 7 Deep
10. Using "D" Bit Cut Ball Seat 13.5 Deep from Face
11. **At 33 on CL**, Drill Ø2.8 x 27 Deep
12. Ream Ø3
13. Drill Ø5.5 x 11 Deep from Face
14. Tap $^{1}/_{4}$" x 32ME - 7 Deep from Face
15. Using Valve Seat "D" Bit Cut Ball Seat 14 Deep from Face



Valve Body Section

DRAWING FP5B
Valve body machining stages

water. With the chuck rotating slowly, heat the profiled end until cherry red is achieved and hold at that colour for about 30 seconds before lowering the blank (still rotating) into the water for at least 30 seconds (Photo 13).

Using a fine oil stone, polish the flat surface of the semi-circular profile, before heating the blank midway with a small gas flame, observing the polished flat surface until a light straw colour is seen to progress towards the profiled end. At that point plunge the blank into a container of cold, clean water, swirling around to hasten the cooling process.

After removal from the water and drying off, check that the colour is between light and mid straw (Photo 14). Using the fine oil stone, lightly polish the flat surface of the semi-circular profile. The D-bit seat cutter is now ready to use, and for the moment should be oiled before putting to one side safely.

Now back to the valve body! By looking at the Drawing FP5 you will see that quite a lot has to happen in a fairly small space – involving five of the valve body's six faces. I have therefore listed the series of stages in the Drawing FP5B, which if followed methodically will simplify the production ensuring the successful completion of a valve body. The only caveat I would add is to take care positioning to the correct datum surfaces that you should mark as the blank is brought to size, so that the orientation is in accordance with each setup given at each of the operational stages on the drawing, provided for the clamping of the blank in the vice.

Referring to Drawings 5/5B;-

Op1) Machine the blank to size, then using a felt tip pen mark the three surface datums (Photo 15). Clamp the datum face to the fixed jaw/end datum to the left. Follow Op1 instructions on drawing 5B.

Op2) Clamp the datum face to the fixed jaw/**end** datum to the right. Follow Op2 steps on drawing 5B – in Photo 16 the M3 hole is being tapped.

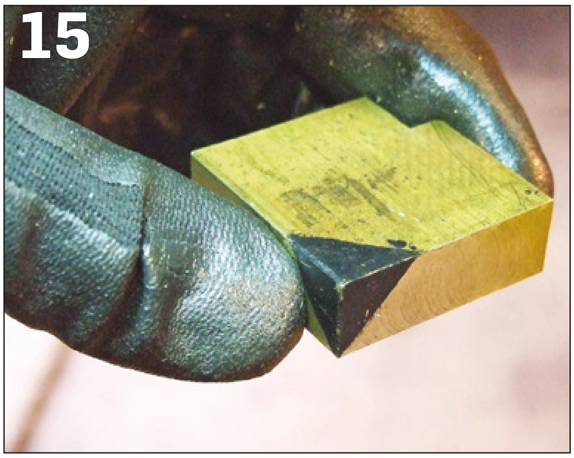
Op3) Clamp the datum face to the fixed jaw/**base** datum to the right. Follow Op3 steps on drawing 5B – Photo 17 shows a slot drill in use.

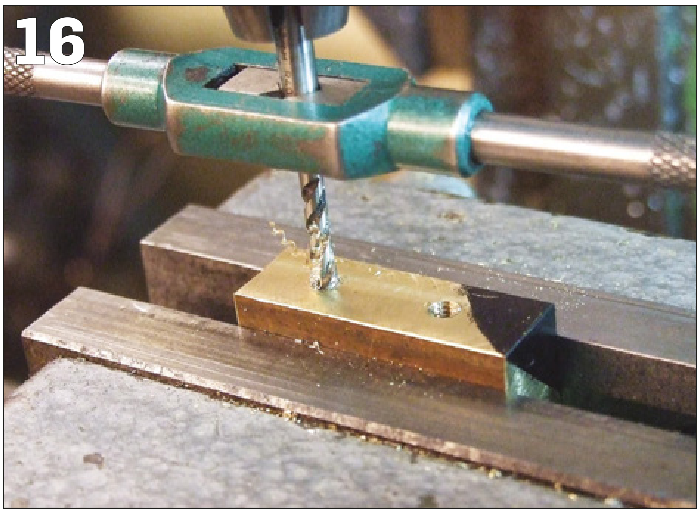
Op4) Clamp the datum face to the fixed jaw/**base** datum to the left. Follow Op4 steps on drawing 5B – Photo 18 shows the thread being cut for the drilling plug.

Op5) Clamp the end datum to the fixed jaw/**base** datum to the right – in Photo 19 a slot drill is in use on the seats for the pipe stubs.

Op6) The next stage is to solder the three stubs and pump cylinder to the valve body. First silver solder the three stubs into the connection face.

Make up from 0.7mm diameter ▶





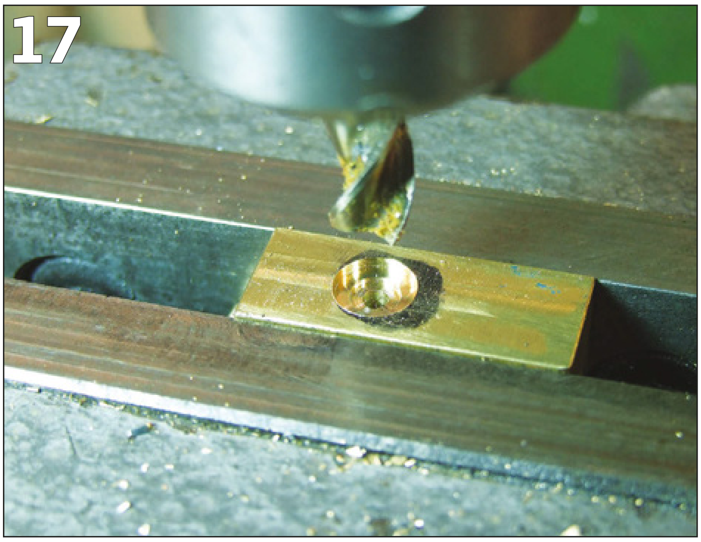


PHOTO 14: A colour between light and mid straw indicates cutter is ready for final polishing ready for use.

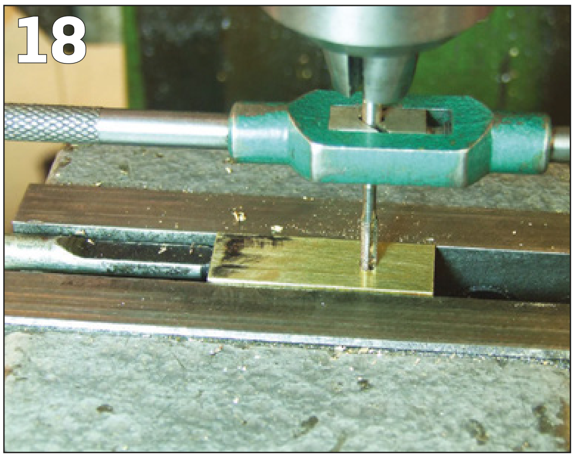
PHOTO 15: After machining of valve body blank, datum surfaces marked with felt-tip pen.

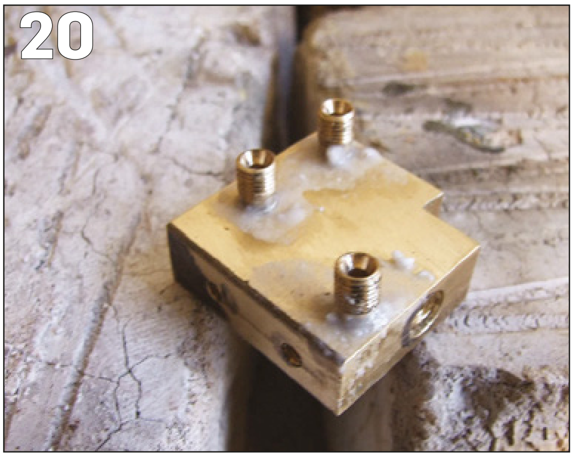
PHOTO 16: Tapping the M2 mounting holes in the valve body using a spiral flute tap.

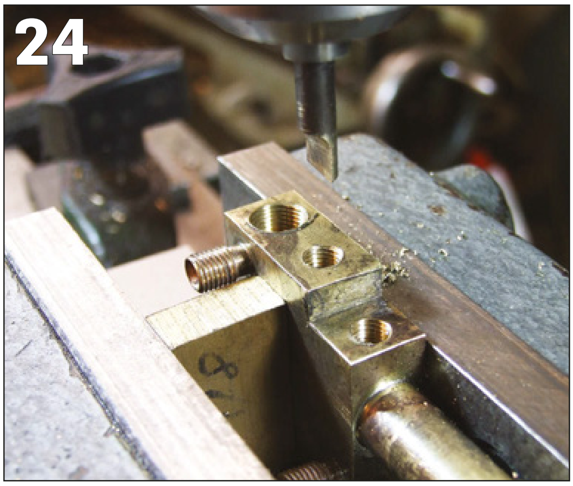
PHOTO 17: Producing the 8x1 register for the cylinder with a slot drill.

PHOTO 18: Tapping M3 for the drilling plug.

PHOTO 19: Slot drill in use again above one of the three pipe stub seats.







silver solder wire LT (55 per cent) three 5mm diameter rings. Put the three stubs and valve body in pickle for 10-15 minutes, drain on removal and wash in clean water.

Fit the silver solder ring over the 5mm diameter plain section on the stubs. Apply flux to the three recesses in the valve body, and locate the outlet stubs into the recess. Push the ring close to the body and then apply flux around the ring and stub.

Lay the body on two fire resistant blocks with a gap between them to allow the flame to be applied below the body, with the stubs facing upwards (Photo 20).

Using a medium burner, direct the flame primarily at the body from underneath with an occasional pass over the stubs above, but avoid directing it actually on the silver solder rings. After the water has boiled off the flux check to see that the rings are still in contact with the body, repositioning any with a scratch stick if they've moved.

Continue heating until the flux goes transparent and shortly afterwards the solder will 'slump' and flow. Allow the flame to pass over the whole assembly whilst you check that a fillet has formed completely around all three stubs. When an acceptable fillet has been confirmed, remove the flame and allow to cool (Photo 21).

PHOTO 20: Pump body set up for soldering in stubs, which are placed in place and fluxed.

PHOTO 21: Heating process underway, checking that solder forms complete fillet around each stub.

PHOTO 22: Cylinder positioned and secured ready for soldering into the pump body.

PHOTO 23: Soldering done, again checking that an acceptable fillet has formed around the joint..

PHOTO 24: Component clamped for final machining process.

Put in the pickle for 5-10 minutes, drain and leave to soak in clean water for 20-30 minutes before removing any flux residue with a stiff brush.

The process is repeated for silver soldering the pump cylinder into the cylinder end face, this time using a ring of 7mm diameter silver solder wire fitted around the pump cylinder, after the body has been positioned with the cylinder end face facing upwards and the three stubs against a fire-resistant block.

Flux around the three previously silver soldered stubs, the recess in the valve body and around the end of the cylinder on which the silver solder ring has been fitted, before positioning the cylinder into the recess and pressing the silver solder ring against the body with a support to ensure that the cylinder does not move (Photo 22).

Using a medium burner directed against the upper end of the plain face with occasional sweeps along the pump cylinder but avoiding direct contact with the silver solder ring, bring the joint area up to temperature. Continue heating until the flux goes transparent and shortly afterwards the solder will 'slump' and flow. Briefly allow the flame to pass over the whole pump cylinder/valve body joint area whilst you check that a fillet has formed completely. When an acceptable fillet has been confirmed, remove the flame and allow to cool (Photo 23).

As previously, put in the pickle for 5-10 minutes, drain and leave to soak in clean water for 20-30 minutes before removing any flux residue with a stiff brush.

Op7) Clamp the datum face to the fixed jaw/end datum to the left. Use a short piece of parallel-sided material to fit between the stubs to enable the vice to clamp the valve body (Photo 24). Follow Op7 steps on drawing 5B.

Drilling Plug

Item FP6 – 4mm diameter brass. Refer to Drawing FP6

On the lathe, hold the 4mm diameter stock with 11mm protruding, and face off. Turn 3.5mm diameter for a length of 8mm. Turn 3mm diameter for 3mm. Thread M3 and part off 5mm long.

Using a standard 32-tpi hacksaw put a slot 1mm deep in the 3.5mm diameter section. EIM

■ **NEXT MONTH:** Martin turns to making the bypass valve.

■ Part one of this series appeared in last month's issue of EIM – you can download digital back issues or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.

Steam joints with O-rings for easy assembly

John discusses the many attributes of the humble sealant.

BY **JOHN BAUER**

I acquired my Simplex about 30 years ago. I had to add crash bars between the guard irons fore and aft as the loco had derailed under previous ownership and damaged the draincock pipes leading to the drain valve block mounted low down between the cylinders.

After some further fiddly minor repairs and replacements the loco was ready to run and it runs very well with all reasonable settings of the reverser. But there is one annoyance common to most models – filling it with water was a pain. I could either use the hand pump, laborious and time-consuming, or remove the safety valves.

Removal of the valves is, of course, straightforward, but their replacement requires soft metallic gaskets and careful attention to tightening to avoid damaging the threads.

I decided upon using O-rings for sealing the safety valve joints and this turned out to be straightforward. I chose an O-ring of suitable size and material and looked up the associated groove dimensions (available on the internet), namely the groove width and depth. These two numbers determine the width and inner diameter of the ring, which with the O-ring inserted, form the seal as per the picture on this page.

The seal works with hand-tightening alone but requires some light further tightening to deal with vibration and shock.

"The advantage of using O-ring seals in our low-pressure applications is that the fittings only have to be tightened until metal-to-metal contact is achieved..."

Not too tight

The advantage of using such O-ring seals in our low-pressure applications is that the fittings only have to be tightened until metal-to-metal contact is achieved. At that point they should not leak; further tightening is only required to ensure the mechanical hold of the connection. For large cross-sections and/or high pressures the liquid or gas forces tending to open the joint have to be taken into account in the mechanical tightening, which is another matter altogether.

In the example shown the O-rings protrude 0.0025-inch (¼00) from either side of the ring, which gives the required leak-free axial squeeze when the safety valves are tightened. Any less and the joint would leak, any more and the O-ring would be damaged upon tightening.

An effective groove size demands careful work. The stress on the metal rings shown (0.729-inch outside diameter, 0.625-inch inside diameter, 0.0575-inch thickness) at 200psi gauge is 1300psi tangential and 200psi radial. The high pressure was used to show that similar rings for plugs for boiler tests are entirely adequate.

I took the standard formula for this situation from Roark and Young's *Formulas for Stress and Strain*, a valuable resource to have to avoid having to mess about with finite element analysis in many common situations.

I have used O-rings in other applications, namely plugs, adaptors, and connections that have to be undone regularly. For instance, the pressure gauge on the Simplex does not read high enough for the annual boiler test. It is fed from a banjo fitting – this has been replaced by another banjo fitting using two small O-rings and it is replaced by a plug, again with an O-ring, for the test.

The O-ring needs to be made from a material suitable for steam service. Once Viton was the only suitable material – today this is available in various grades as well as other materials that are suitable for steam service. This means that you must be aware of the makeup of the particular material you are offered, even if it is labelled Viton.

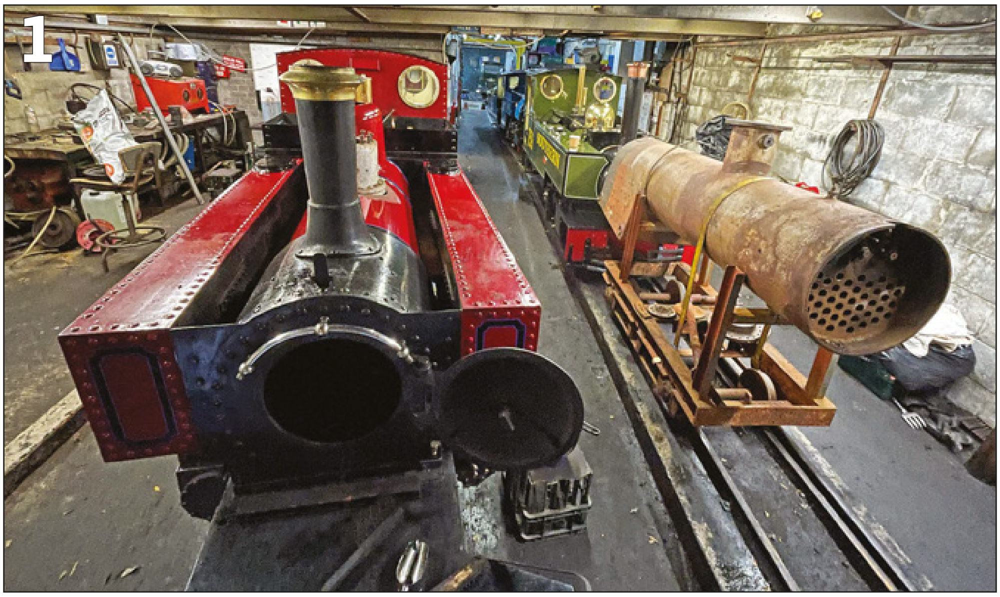
I buy my O-rings at the local hydraulic supply shop, which is faster and cheaper than having them come by mail.

■ Do you have a loco improvement tip that fellow readers would find useful? If so send it in to the editorial address on page 3.

Boilers, brakes and more

This month our resident Fairbourne Railway engineer faces the demands of 12¼-inch gauge boiler tests and de-snagging a newly overhauled diesel loco...

BY **HARRY BILLMORE**



The past month in the workshops of the Fairbourne railway has been a little manic, though mostly with regard to meeting deadlines as opposed to facing major problems with the fleet.

One of these key deadlines was the boiler inspector coming to carry out the annual exam on out 6-inch scale Welsh Highland Railway-style 2-6-4T 'Russell', along with the biannual exam of our compressor and an internal exam on the boiler of our North Wales Narrow Gauge Railway 0-6-4T 'Beddgelert', the overhaul of which we are just beginning ahead of a planned return to service.

To prepare for this the tubes needed to be removed from Beddgelert's boiler, before all the scale could be washed out along with the various bits of detritus that had been dropped into the boiler during its years on display in the railway's museum – remarkably these included bits of ballast and even a key ring.

To remove the tubes I found the easiest way was to cut a 6-inch section out of the middle of each tube, by reaching through the dome, then to drive the tubes back into the barrel with a good-fitting dolly before feeding them out through the J-pipe hole in the front tubeplate.

This of course necessitated the removal of the J-pipe and regulator to allow access through the dome, a job that took me all day – the removal of two bolts and the unscrewing of the j-pipe components fought me all the way. Some seven years in traffic and another 10 years or so on display had ensured that the fixings did not give up without a fight.

Scale of the problem

Finally with all the tubes removed and as much of the loose scale as possible swept and vacuumed out of the barrel, I could have a decent look at the condition of the internal surfaces. Apart from some pitting in the bottom of the barrel and the fusible-plug fitting threads being tired it didn't look too bad, though I did notice that the girder stays were completely full of scale. This was remedied quite quickly by turning the boiler upside down in its cradle and poking and prodding through the gauge frame fittings.

There are a couple of changes that

I will be making to the boiler to aid its longevity. One will be fitting a washout plug into the front tubeplate under the tube nest to allow any scale to be jetted out along the length of the boiler barrel during the normal washouts carried out throughout the season – the other is to fit a washout plug on the backhead to allow jetting of the top of the firebox.

With Beddgelert's boiler ready to be pressure washed, finally attention turned to preparing Russell for its exam. Handily our Editor was free to come and help, which made my life considerably easier!

A long list

The things to prep are: remove the firebars, remove the fusible plug, remove all the washout plugs, remove the blowdown valve, remove the whistle and fittings, remove the dome top, remove the gauge glasses for inspection, remove the end caps from the gauge frames to allow for checking of the water passages and finally use the pressure washer to jet the boiler clean of scale and sediment build-up.

When you write the list like that it sounds quite easy and simple, unfortunately it isn't as easy as all that. To remove the front right-hand foundation ring washout plug you have to first take off the steam supply and delivery pipes from the injector as they foul the access to the plug. To remove the blowdown valve and fittings you have to get everything into perfect alignment and then take off the handbrake as the linkage fouls the valve as it turns. To remove the front tubeplate washout plug you are working blind as it is sat directly behind the main steam pipe which drops straight down in front of the tubeplate, and so on, and so on... (*I can confirm that just about everything that needed getting to was trapped behind something else! Ed*).

PHOTO 1: Awaiting washout prep in the Fairbourne workshop – 'Russell' and the boiler of 'Beddgelert'. Lynton & Barnstaple style 2-6-2T 'Yeo', visible behind, will have its turn later in the off-season. *Photo: Andrew Charman*

PHOTO 2: The view through the j-pipe aperture into Beddgelert's boiler.

PHOTO 3: All of the tubes cut and half of them removed – you can see two of the longitudinal stays that made reaching into the bottom of the barrel a challenge.

PHOTO 4: The sections cut from the centre of the tubes with a gas axe.

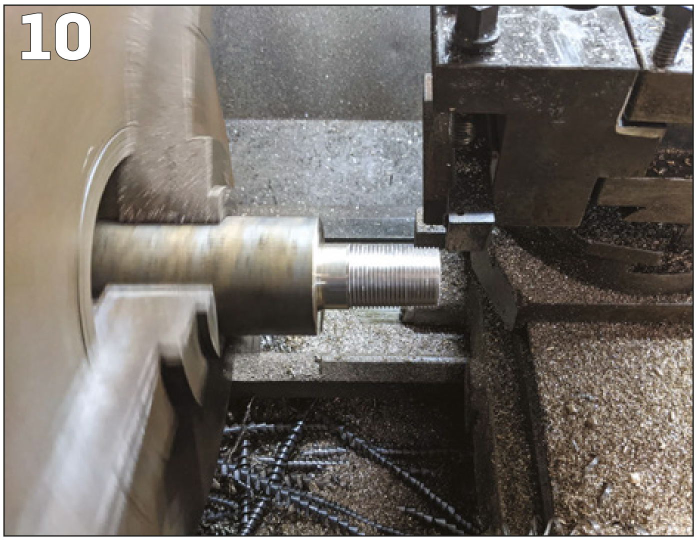
PHOTO 5: The front half of the tubes, they are not in too bad a condition with a bit of pitting and a little necking towards the firebox end.

PHOTO 6: Russell's whistle came off without too much difficulty – though not that much else did... *Photo: Andrew Charman*

PHOTO 7: Trolley good fun – Harry pushes Beddgelert's boiler towards its appointment with Andrew and a pressure washer. *Photo: Andrew Charman*

PHOTO 8: Armed and dangerous – Andrew jet washes the scale out of the boiler, evident in the dirty brown water pouring from the washout hole.

All photos by the author unless credited



Once Andrew had removed everything and started to pressure-wash it all, I examined the components. Both of the rear foundation-ring washout plugs were showing signs of necking, this is usually due to their repeated removal and replacement starting to wear the bronze threads. These needed replacing as necked plugs can cause major issues in sealing.

Unfortunately our spares plugs of the standard size disappeared below the edge of the boss as I screwed them in, while the standard oversize plugs we have started to tighten as the top of the plug passed the top of the boss, so I needed to make some oversized, oversized plugs.

Handily I had available the hydraulic copier attachment on the lathe (described in detail in the May 2021 issue of EIM) and a laser cutter at home. I checked the thread dimensions to determine the correct taper and thread angle before cutting a pattern in 3mm acrylic on the laser cutter that evening and then machining the plugs the following day – have a look at the attached pictures to see how it all works. If a little more time had been available I would have machined a hex head onto the plugs to allow a normal socket to be used on them, making life easier when doing washouts, but that will have to wait for the next time.

Visual exam

Once all the preparations were complete, our boiler inspector came and carried out the visual inspection of Russell, before taking thickness readings of the platework to ensure there were no surprises lurking out of sight. With the loco having passed its cold exam he then went to make the examination of Beddgelert's boiler and the compressor, while I refitted all the components we had so recently taken off Russell to then allow us to steam it.

The inspection of Beddgelert didn't reveal any more unexpected issues and the inspector was very happy with the modifications we proposed, so we can proceed with the boiler at a later date when the overhaul of the chassis is somewhat closer to being completed.

PHOTO 9: The 3mm acrylic pattern cut out on Harry's laser cutter at home in use on the works lathe's hydraulic follower – the follower is part way along the taper.

PHOTO 10: Thread cutting on the first of the new oversize plugs using the hydraulic copier.

PHOTO 11: Machining the square head on the end of the new plugs using a pipe fitting in a rotary table – so long as the taper plug is snugged down tightly this method of holding works well.

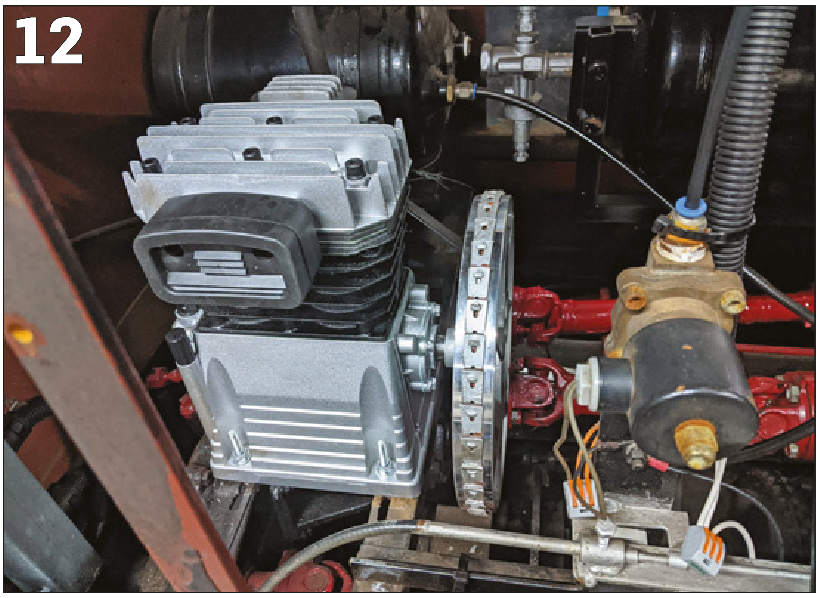
PHOTO 12: The new two-cylinder compressor installed in the bo-bo diesel 'Tony'.

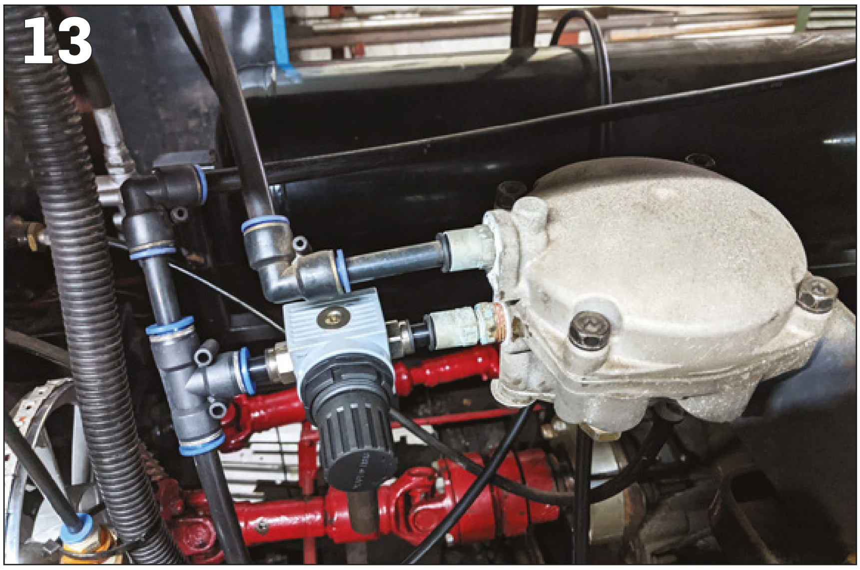
PHOTO 13: The pressure regulator and brake distributor for the loco.

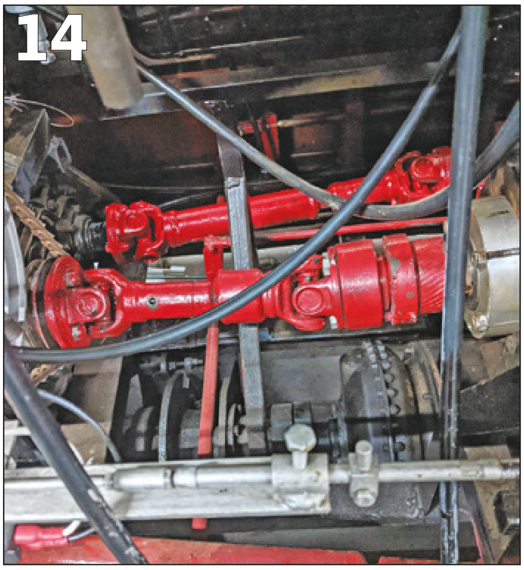
PHOTO 14: A view of some of Tony's drivetrain – the engine is to the right, the scout car gearbox to the left and you can just see the v-belt drive for the compressor.

PHOTO 15: The Dingo scout car gearbox – the input from the automatic gearbox is on the right and one of the output shafts is on the left.

PHOTO 16: One of the offending fluid flywheels, the output from the automatic gearbox is on the left, the output from the Dingo is on the right with the belt drive just out of sight at the top of the picture.







The reason why I had the boiler inspected now, with the rebuild of the loco hopefully planned to take around two years, is so that if there any big issues had been revealed we would have the time to rectify them before the chassis is completed.

Once Russell was back in steam the usual tests were conducted, these including ensuring there are two methods of putting water into the boiler, and that the safety valves operate at the correct pressure and cannot be overwhelmed by the fire. With this final test complete Russell was given a clean bill of health and will now be winterised (prepared for winter storage, including such measures as draining the boiler and removing all water from the pipework) until I come to do the annual maintenance tasks.

The other main project I have been pressing on with in recent weeks has been Tony, our bo-bo diesel which has been under an extended overhaul. The loco has had quite a lot of work done to it over the last year and is now approaching final finishing and commissioning. However the first test movement under its own power (described in last month's column) showed up a few issues, one of which being that the brake system was operating at the same pressure as the reservoir, with a compressor that was not providing enough air.

> *"The fluid flywheels on the nearly final drive were not working anything like as well as they should and were operating far better in one direction than the other..."*

This meant that after a short amount of shunting using the air brakes, the air pressure applying the brakes becomes higher than the reservoir pressure with the result that you then cannot get the brakes back off until the compressor has caught up again.

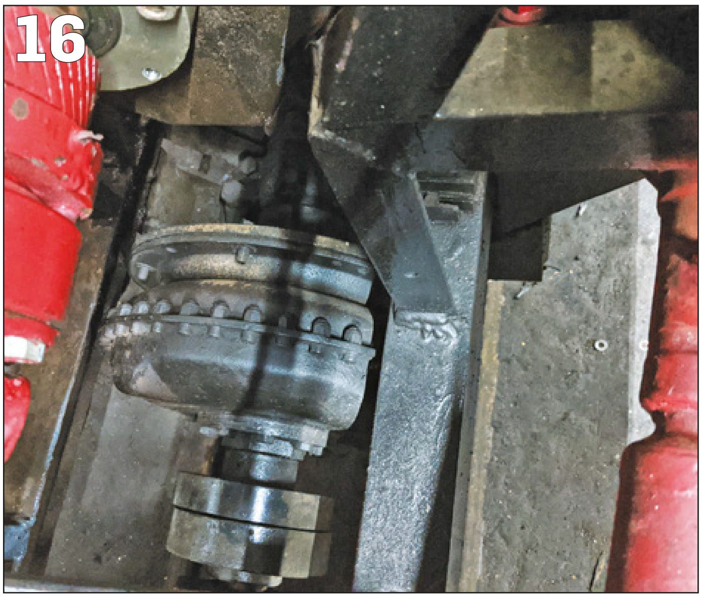
One-way flywheel

The other reasonably major fault that the test run showed up was that the fluid flywheels on the nearly final drive were not working anything like as well as they should and were operating far better in one direction than the other. The drivetrain of Tony is somewhat complicated and has been adapted over the years due to the use of several different engines, gearboxes and shafting.

As the loco currently stands it has a 300tdi Land Rover diesel engine driving through the automatic gearbox from the Discovery that it came with. This gearbox has had the transfer box removed and the drive taken directly from the four-speed gearbox via a propshaft to a Daimler Dingo scout car forwards/reverse/neutral gearbox – the propshaft is where the drive for the compressor is taken from, so the auto box must be in drive for the compressor to be running.

The drive is then taken from two of the outputs from the scout car gearbox via propshafts back towards the engine where there is a pair of belt drives in a V to an idler shaft under the engine. There is a fluid flywheel on each end of this shaft which then drive via another pair of propshafts the final drive gearboxes on the axles.

Watching the drivetrain as the loco was moving, you could see the fluid flywheels being spun up but not transmitting the drive to the final drive propshafts. I suspected the oil levels in the flywheels initially but having had an opportunity to sit and ▶



think on it for a little while I am starting to think the problem is more to do with one of the flywheels always being turned in the opposite direction to that which it was intended.

The flywheels I am told came from a pair of Dingo scout cars the railway acquired at one time, parts of which ended up on 'Dingo' the loco while other bits ended up on 'Sylvia' which has since been renamed Tony. On the scout cars and every other fluid flywheel I have known they are placed on the engine output to allow for gear changes and smooth application of power acting in a similar way to a clutch (albeit with fluid dynamics instead of friction plates and such). I think I am right in saying that fluid flywheels are unidirectional and do not work anything like as well being driven in the opposite direction to that they were designed for. I would very much welcome views on this subject!

Uncertain future

My initial response was to change the oil in the flywheels and top them up to the correct levels – you can see the colour of the oil that came out in the picture. This has helped matters but I still think the fluid flywheels are not acting correctly and are probably not worth having in the drive system at all.

The air system fix was quite simple – a pressure regulator to the air distributor and fitting a new compressor with twice the flow rate of the old one has cured the issue of the brakes not releasing!

There has been lots happening around the railway elsewhere – one of the carriages has had a large amount of panelling and some framework replaced before undergoing a full repaint and is now emerging into the daylight again.

Meanwhile down at the other end of the line the p-way gang have been hard at work on the replacement of the tunnel roof, an ongoing project to renew a section each winter as the original structure was not the best. In next month's article I will hopefully be documenting Tony's return to use and I will give a full detailed report of the work carried out. EIM

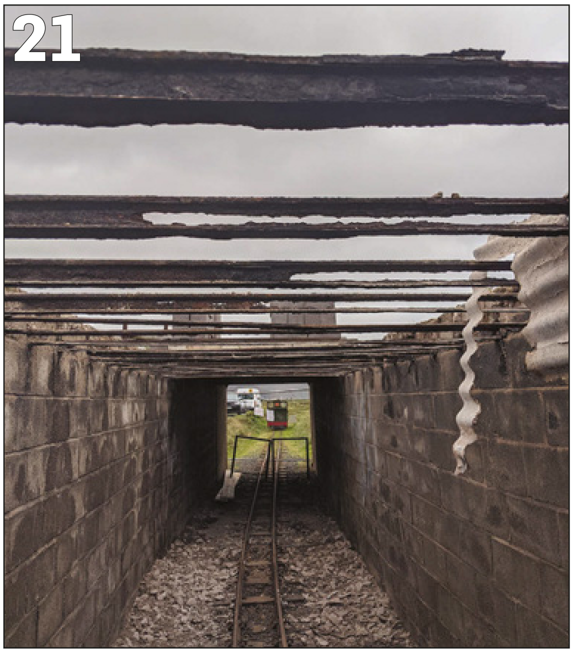
PHOTO 17: The colour of the oil from one of the flywheels – this is supposed to be red automatic transmission fluid.

PHOTO 18: Carriage 16 freshly repainted and ready to re-enter traffic

PHOTO 19: Tony out on a test run along the line.

PHOTO 20: A pause for checks, looking up the Mawddach estuary on a dull, wintry day.

PHOTO 21: The tunnel roof removed for renewal.



Awkward shapes in the mill

Harry tackles another problem that can tax model engineers working in any scale.

BY **HARRY BILLMORE**

Recently on the Fairbourne Railway our 6-inch scale Lynton and Barnstaple 2-6-2T 'Yeo' bent its left-hand side upper guide bar and so I needed to make a new one. I took the opportunity to beef it up a little bit as those already on the loco are a little spindly.

These guide bars are a slightly awkward shape to machine as they are not just straight bar – each original was fabricated from two pieces to create a T-shape with the wider end towards the cylinder to allow room for two fixing bolts.

I decided to employ a method of workpiece holding from CNC-mill production practices – this offers two main advantages, the first being that it makes it far easier to hold the bar and the second being that it reduces the tendency of bar stock to spring after a large amount of material has been taken off.

The process is simple, starting with obtaining your material in a thicker billet than normal, usually by a few mm. You then hold the billet in the vice so that the full thickness of the piece you are trying to machine is out of the top of the vice and you then machine the shape out down to the top of the vice.

Once the machining operations are completed on one side you can either flip the billet straight over and use a face cutter to take the extra material off, or as I had to, cut through the thin material left around the outline before then fitting it back into the vice. A simple solution to a knotty little problem. EIM

PHOTO 1: The old bent guide bar requiring replacement – note the weld at the junction of the T.

PHOTO 2: Profile view of the old guide bar showing the bend formed in it.

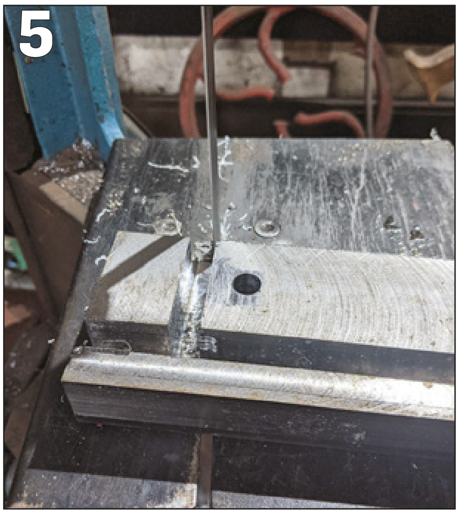
PHOTO 3: Machining the outline of the replacement piece down to depth with an end mill.

PHOTO 4: The completed outline of the new guide bar.

PHOTO 5: Using the band saw to cut the excess away from the finished shape.

PHOTO 6: A face cutter is then employed to remove the excess from the back side of the work piece.

PHOTO 7: The final thickness and shape emerging from the steel ready for grinding and hardening.



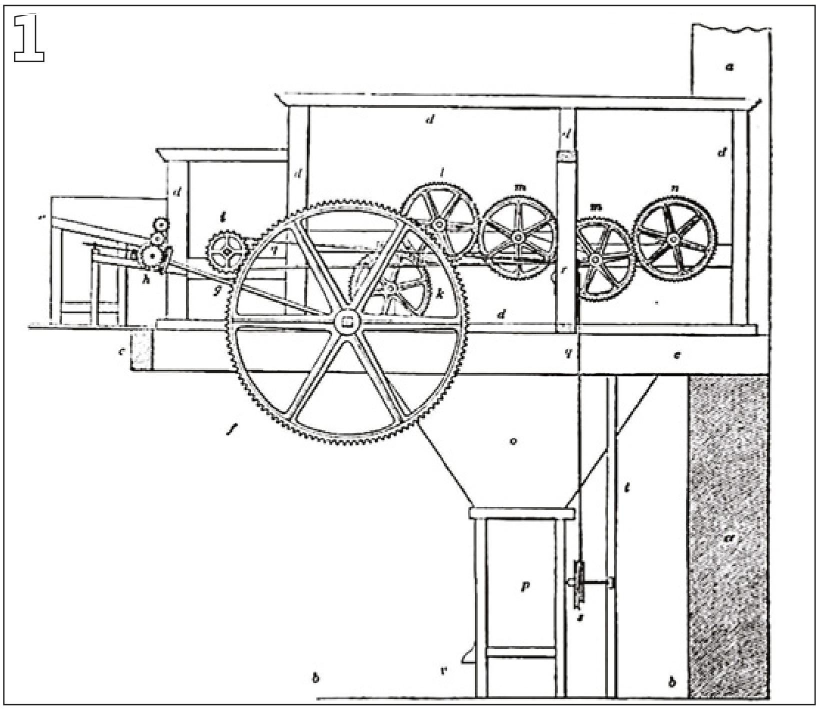
Steam on the Farm

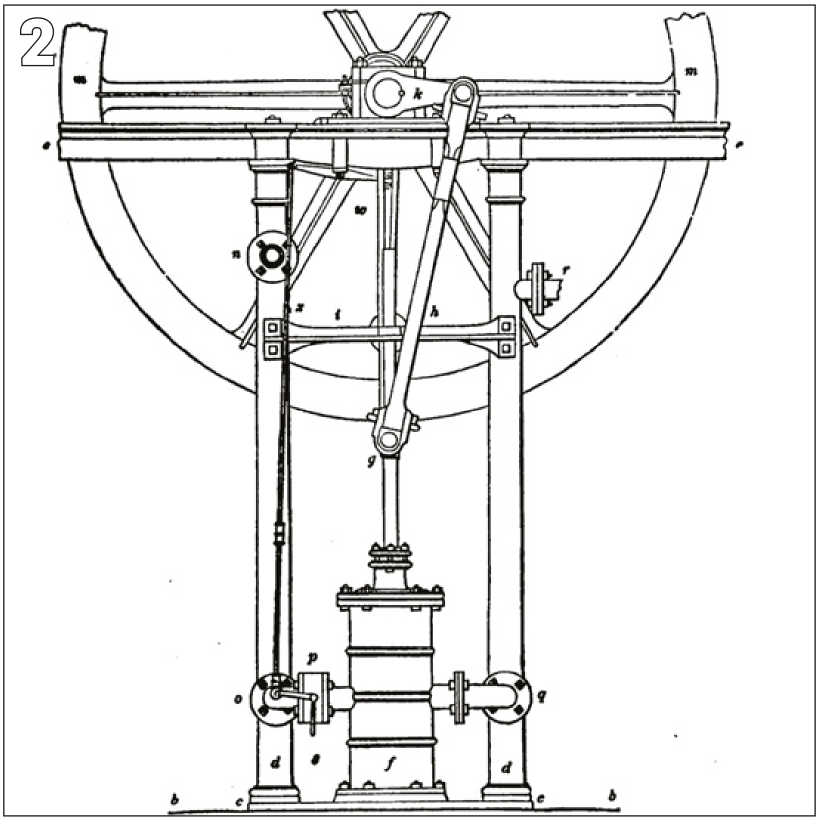
In his latest study of steam applications in industry, Rodger looks how the technology replaced the horse in agriculture only to fall victim to the internal-combustion engine

BY RODGER BRADLEY

When I was a child, we lived on a farm, a dairy farm, and although I didn't know it at the time, one of agriculture's famous innovators, Jethro Tull (no, not the rock band) once lived there, and his part in the development of the plough was certainly a key milestone.

I do remember seeing a threshing machine used to separate the wheat, before a combine harvester arrived, and to me it seemed like a jumbled collection of clattering links and levers. Power was derived by means of a flat belt from the pulley on the side of a Fordson tractor – diesel powered – that had replaced the earlier steam-driven portable or traction engine.





"The steam engine needed to be mobile to challenge the farmer's most useful tool, the horse, but the early road-going engines were far too heavy to be of use in the fields..."

PHOTO 1: A section through a typical early 1800s threshing machine housed in a farm building and which could be driven by horse, water or steam power.

PHOTO 2: A 'crank engine', typical of those used on small farms in the mid 1800s. This example is one of the more common arrangements, although some farms used Newcomen-style beam engines.

Both images: Book of the Farm, *second edition, Henry Stephens 1854*

Steam power played its part in the agricultural revolution, which followed the revolution in working practices brought in by the 'Enclosure Movement', and early mechanisation, including those threshing machines that contributed in no small way to the 'Swing Riots' of 1830. But, as elsewhere in the early Victorian era, the revolution in all industry moved on, and for the farmer the emerging challenge was how and where to deploy the new steam technology.

Stationary start

For some years the use of steam was confined to stationary steam engines from which power was obtained to drive threshing machines, millstones, chaff cutters and the like, whilst ploughing remained in the hands of the trusty horse. In fact, mechanisation of the farm, whether steam powered or horse drawn, included a range of innovative machinery, mowers/hay cutting, corn/wheat reapers and reaper binders, as well as the usual tools for turning the soil and sowing seeds. Steam power was also applied to threshing in a barn, where traditional horsepower had been used previously.

Many of these were stationary operations in the farm yard or its immediate surroundings, and it was well into the mid-Victorian era before portable steam and traction engines began to be used extensively out in the fields. Making the steam engine portable paved the way for wider improvements and efficiencies in the business of farming.

In Henry Stephens' 1844 *Book of the Farm* (a second edition published in 1854), he makes a number of important observations about the use of steam power on the farm, and whilst threshing machines were still confined to an in-building structure, the stationary steam engine used to drive them was either a beam or crank engine. In his treatise, he comments;

"Although coal should be both distant and dear, for all that a steam engine requires, a steam engine should be erected in preference to

PHOTO 3: Classic portable steam engine from Clayton & Shuttleworth in 1850. Note harness for haulage by horse, and some impressive data about the engine's cost and efficiency. *Image courtesy HathiTrust.Org*

using horses in the thrashing-machines; for besides having to keep a larger number of horses on a large farm, in the proportion of one pair in every five pairs, the tear and wear of horses in the rotary motion of the horse-course is very considerable."

For wider use the steam engine needed to be mobile, from which position it could then challenge the farmer's most useful tool, the horse, but the early road-going engines were far too heavy to be of use in the fields. The first practical applications would arrive with higher-pressure boilers, in a similar way to the changes that were made possible in transport and industry, and these arrived in 1841.

Wheels but no propulsion

In order to compete more effectively with the horse in the countryside, by 1850 the steam engine had become portable – not self-propelled, just portable. This was key to the introduction of other innovative machines, to allow threshing to take place in the field and not a specially constructed building with a horse powered 'gin' – its arrival was not favourably received by farm labourers. The threshing machine was a key driver of the Swing Riots, which were widespread uprisings in 1830 by agricultural workers in southern and eastern England protesting over agricultural mechanisation and their harsh working conditions. However the threshing machine continued to be deployed in the 1830s across the country, and the horse was gradually replaced by a steam engine.

Later still, the first portable, steam-powered threshing machines arrived, with the initial version produced by J. R. and A. Ransome of Ipswich in 1841. According to the maker this machine was intended to be moved between farms as much as around individual farms themselves, as it was mounted on a substantial chassis to be pulled by horses. In the following year, 1842, Ransomes produced the world's first self-propelled steam engine – this was the predecessor of the true agricultural traction engine.

Threshing machines were widely used in Scotland under horse and manpower until well into the 1800s, and whilst static steam engines were available for use, the portable engine did not arrive until 1850, when the first example was displayed at the Glasgow Highland Show. Most 'new technology' used in agriculture was developed in Scotland – particularly in the south and east.

The Ransomes 'portable engine thresher' of 1841 was exhibited at the Royal Agricultural Society's exhibition held in Liverpool that year, and its portability consisted of having it mounted on a two-wheeled carriage pulled by a pair of horses. The machine weighed 35cwt and, according to the makers, provided a power output equivalent to five horses, for a fuel consumption of 1½ cwt of coke per hour, and 36 gallons per hour of water.

A curious feature of the design was that the exhaust steam passed to the chimney where the condensed water was intended to douse sparks and reduce fire hazards – not a bad idea in a field full of corn!

At the 1850 Highland Show, the first steam powered exhibit – a 7hp portable steam engine for threshing and other purposes, was entered in a class described as 'extra implement', and was built by Clayton, Shuttleworth and Co of Lincoln. At the same show, one of the most

PHOTO 4: More than a century after photo 3, a Ransomes portable drives a Ransomes threshing machine by belt. The display is part of the annual Little Casterton working weekend. *Photo: Michael Trolove, Wikipedia Commons*

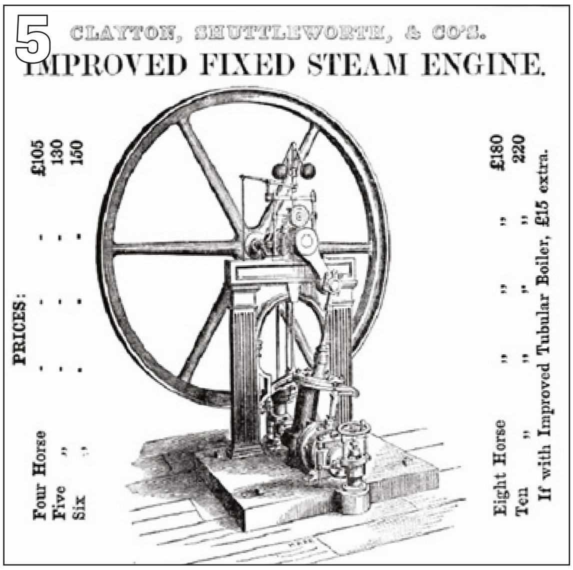


PHOTO 5: A further example from Clayton & Shuttleworth's 1850 catalogue, the oscillating cylinder steam engine. *Image: courtesy HathiTrust.Org*

famous names, Richard Garrett and Son, of Saxmundham, also exhibited a portable steam engine for agricultural purposes.

The portable engines were – to all intents and purposes – a railway locomotive style boiler with a small firebox fuelled by coal. The use of coal on a stationary engine on the farm itself was more an economic challenge than an operational one, and in Stephens' 1841 text he advocates using 'large coal' when the farm is not near a coal mine, adding that a 6hp 'engine' fired this way will be operational for one hour. So, for a 6hp portable, having access to that fuel would mean either carting it on a separate trailer, or returning to the farm for another hundredweight to carry on working, and that also included providing a water supply.

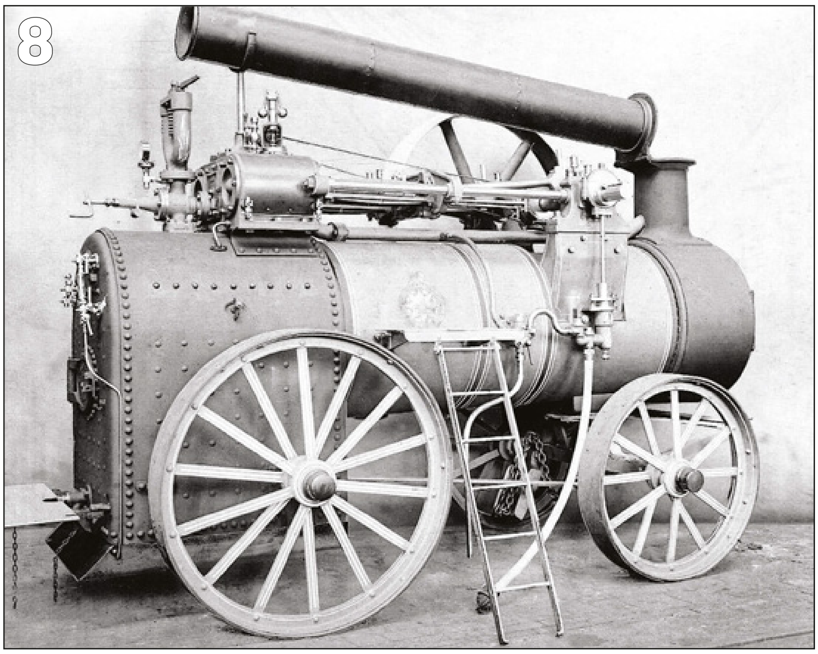


PHOTO 6: The classic match-up of traction engine and threshing machine. This demonstration with a Ransomes threshing machine was at the Dorset Steam Fair in 2008. *Image: Thomas Weise, Wikipeda Commons*

PHOTO 7: Top-end ploughing power – a Fowler from 1919 also known as the 'Improved Compound Type'. The cable reel is clearly visible beneath the boiler. *Image: Barry Skeates, Wikipedia Commons*

PHOTO 8: A classic steam portable engine for the farm – this Robey example shows its hinged chimney for easy movement and storage. *Image: Wikipedia commons*

The road towards self-propulsion on the land was strewn with ingenious techniques for mechanising activities with which the horse, and later the tractor, had been and would be indispensable. Ploughing was one area where a self-propelled, as opposed to a portable engine would find most use, but actually moving its own weight across a field demanded as much power as for the ploughing operation itself.

In 1808, an idea which progressed only as far as the Patent Office almost invented the steam turbine by mistake. John Dumbell devised a self-propelled ploughing machine where steam acting on a series of vanes contained in a tube or cylinder caused them to rotate, with the shaft to which they were attached geared to drive the vehicle's wheels.

In this design the plough was directly attached to the machine, and simply dragged across the field, but it was not a success and even the method disappeared from view for many years.

Connected by cable

The most successful and longest-lived ploughing method involved long cables connecting portable steam engines on either side of a field, or a single engine and a capstan winch, and was devised by an Englishman, J. Loudon, in around 1830. The following 20 years saw a raft of patents for steam cultivating machinery, and in 1854 the Royal Agricultural Society of England (RASE) offered a prize of £500 for a steam-powered machine that would be a suitable "economical substitute for the plough or spade". It was actually four years later that the prize was awarded to John Fowler of Leeds for his design.

The winning arrangement consisted of a 10hp portable steam engine, built by Ransomes of Ipswich, and fitted with a twin-drum windlass built by Robert Stephenson of Newcastle, which was attached under the engine's smokebox. On the opposite side of the field, the Ransomes-built 'anchor carriage' – a design also produced by Robert Stephenson – was linked by ropes and the plough drawn backwards and forwards, the whole assembly moving forward at the end of each pass.

Various modifications to both these basic ideas took place in ensuing years, using rails, tracks and various other techniques to move the engine and plough, but until the development by Ransomes none could combine the features of self-propelled and portable engines. The most successful would use steam power not only to turn the vehicle's wheels, but also to pull a plough, or drive other farm machinery such as threshing machines.

One fascinating option to try and provide some mobility in tilling the field arrived in 1855 – described as the 'Guideway Steam Agriculture' system, it was designed by a one Peter Halkett, a naval officer. This has been likened to having a railway in the field, and consisted of metal rails laid in the ground between 30 and 50 feet apart, with a steam engine and trailer running on one rail, linked to the other rail by means of a platform.

The arrangement was clearly intended for market gardens, and the platform could be fitted with cultivation tools for ploughing, depositing liquid manure, and seats for operators planting seedlings – but it was a cumbersome arrangement. The obvious problem was the difficulty of moving the assembly from one location to another, even within the market garden.

Ironically perhaps the general principle was re-used in the 20th century, as gantry tractors, which were devised by a Cotswold farmer, David Dowler in the 1970s. These gantry implements have been and are used for tilling the soil, weeding and seeding to this day, albeit with diesel power and not steam.

From the 1840s, Ransomes of Ipswich established itself as one of the principal agricultural engine builders, although there was competition from Clayton and Shuttleworth of Lincoln, and John Fowler of Leeds. Some interesting features of the more successful designs of the mid 19th century included an elementary power take-off shaft, which was seen on the Ransomes and May 'Farmers Engine' of 1849.

This particular self-propelled engine was gear driven from a steam engine built by E. B. Wilson of Leeds, which allowed two forward speeds on the road. Luxuriously, it had springs on the rear axle. However, unlike the earlier Ransomes self-propelled design of 1842, the 'Farmers Engine' had no pulley for working stationary machinery; hence the power take-off connection to the engine's crankshaft.

Royal progress

The Royal Agricultural Society of England offered the greatest encouragement to the developing use of steam power on the land, holding annual trials at various locations, coinciding with the Society's agricultural shows. Many of what later became famous names in the steam and traction engine industry appeared at these events. In 1860, at the Canterbury Show, a Fowler 12hp ploughing engine produced the highest power output, using a cable and pulley system for the actual ploughing, and tilled some six acres in ten hours. This was said to cost 42p an acre, or 60 per cent less than what could be expected from a team of horses.

In the second half of the 19th century, the economics of steam power in the fields began to appear in the forefront of arguments in favour of its adoption over more traditional methods. Even taking into account the total costs of purchase of all the equipment needed for steam ploughing – using cable and windlass methods – the overall costs could still be less than using horses.

The real challenge was that farmers on the whole could not afford the expenditure on steam-cultivation equipment, especially considering that a ploughing engine would only be used perhaps once a year. By 1870 most ploughing was done by contractors, moving from farm to farm, and this was driven forward by the arrival of self-propelled engines.

Some of the earliest designs of the self-propelled era used fairly crude

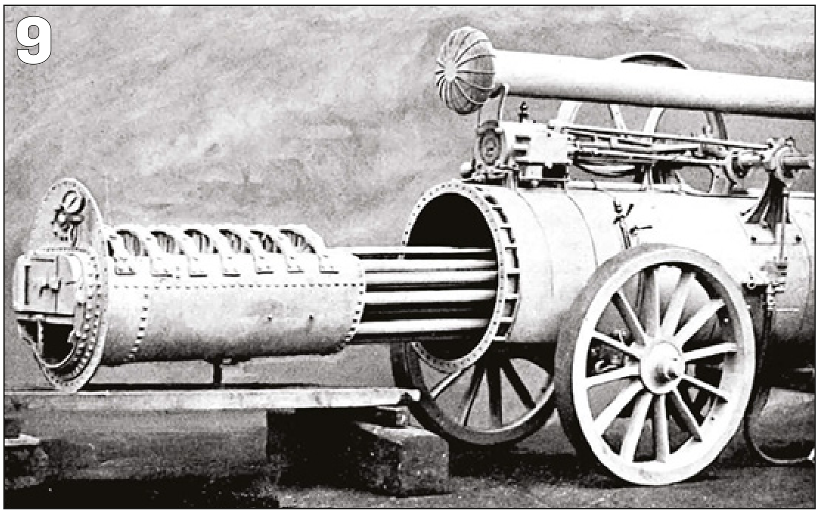


PHOTO 9: Innovative idea from Ransomes & May in the 1850s/60s to offer removable boiler tubes. The idea was to illustrate ease of maintenance and repair. *Image: Grace's Guide*

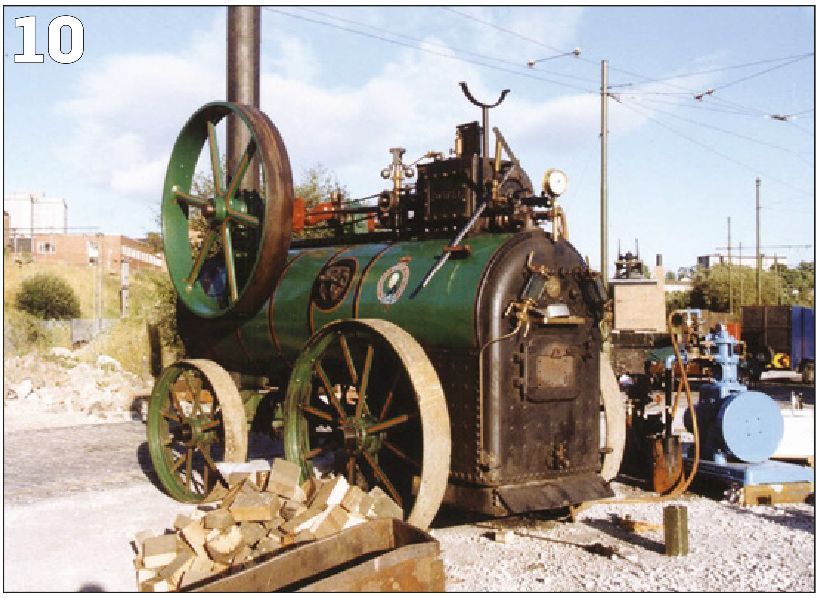
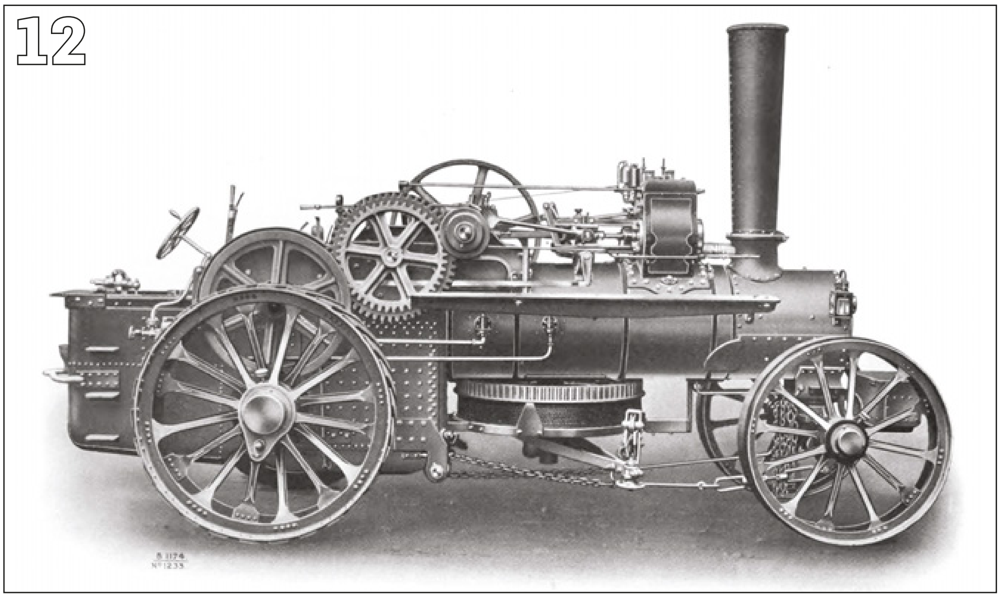


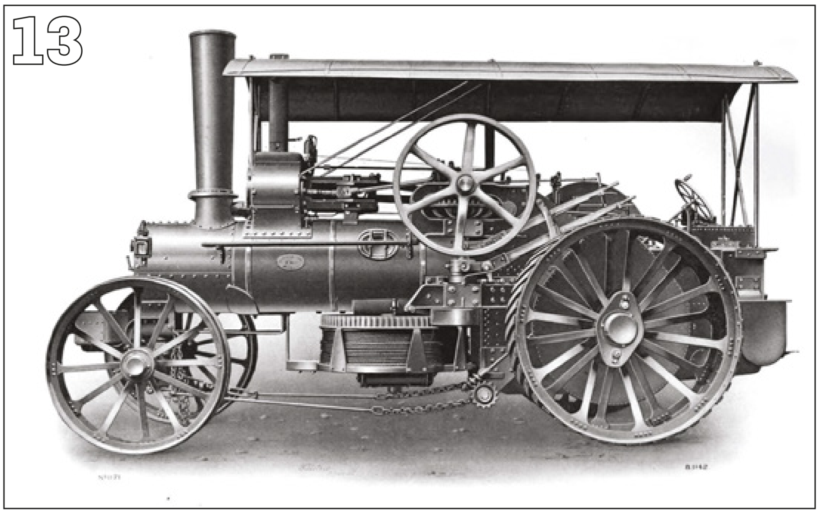
PHOTO 10: A long way from home a portable built by William Foster & Co of Lincoln, now at the Summerlee Heritage Museum in Coatbridge, Scotland. *Image: Roly Williams, Wikipedia Commons*

PHOTO 11: An evocative engraving from John Fowler's 1909 book shows how a five-furrow plough on a cable system would have been marketed to customers. This view was taken on a farm in Germany. *Image:* Steam Cultivating Machinery *by John Fowler, published 1909*



'driving', or more particularly manoeuvring arrangements. It is worth noting that steering an agricultural traction engine in the 1800s was no easy matter – some oddities emerged, such as a fifth wheel operated by a tiller from the front of Thomas Aveling's early designs.

Many builders still preferred to use a horse in shafts attached to the leading pair of wheels – even in self-propelled engines – and others located a steering position on a platform attached to the front of the engine. With this last method, the driver sat on a seat facing a large steering wheel, to which a worm/worm-wheel assembly was attached in order to redirect the movement of the front wheels.



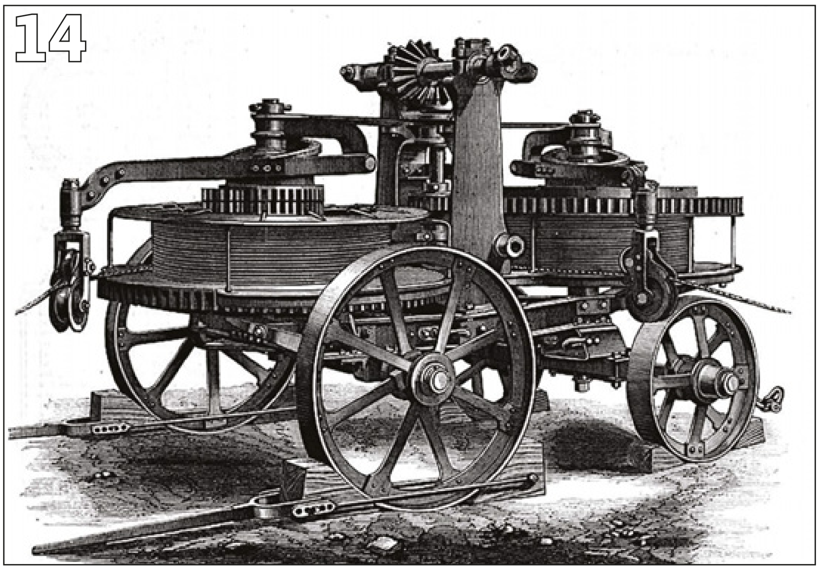


PHOTO 12: Another great example of the range of ploughing engines made by Fowler, this one described as 'improved' and 'self-moving'.

PHOTO 13: Whilst coal was the principal fuel used by both portable and self-propelled steam engines on the farm, there were a number that were built for oil-firing. This is a Fowler design.

PHOTO 14: The other end of the cable-ploughing system, which provided the anchor as a windlass at the other side of the field. This example was part of John Fowler of Leeds' system in 1874

All three images: Steam Cultivating Machinery *by John Fowler, published 1909*

It seems, surprisingly, that nobody went in for the Ackerman method which had been invented by German wheelwright Georg Lankensperger back in 1817. This arrangement of linkage provided the necessary geometry to allow the inner and outer wheels to turn whilst following circles of different radii.

Whilst threshing powered by a steam engine had been used commercially for some time, it was not until 1876 that steam was successfully employed for reaping as well. In that year, an Aveling and Porter traction engine took part in a series of trials of various makes of reaper and was itself paired for the tests with a Crosskill reaper.

The technique involved the traction engine pushing the reaper, which was driven by chains from the engine's flywheel. In order to manoeuvre the contraption, notably at corners, a gantry and steam-operated lifting mechanism was attached to the front of the engine, so that the reaper could be raised clear of the ground.

Power output rose rapidly towards the close of the 19th century and during the early years of the 20th, as the industrial revolution's population explosion demanded more produce from the land. Mechanised farms, along with steam engines had achieved an acceptable level of reliability and operating performance by 1900, and many different makes could be found working on farms around the country.

The names on the list below would have been very familiar to the farmers of yesterday, and represented examples of the ultimate development of steam power on the land:-

- Smith & Ashby, Stamford, Lincs
- Brown & May; Devizes, Wiltshire
- Ruston Proctor; Lincoln
- Marshall; Gainsborough, Lincs
- Ransomes, Simms & Jefferies; Ipswich (formerly Ransomes & May)
- Garrett; Leiston, Suffolk
- Burrell; Thetford, Norfolk
- J. Fowler & Co.; Leeds, Yorkshire
- Aveling & Porter; Rochester, Kent
- Clayton & Shuttleworth; Lincoln

A new rival

Although the internal-combustion engine made its first appearance in the USA in 1889 its development in this country led it to challenge the recently acquired supremacy of the steam engine early in the 20th century. Fowler of Leeds produced an internal-combustion engine for ploughing in 1912, but, like all the early tractors, it resembled the steam engine closely in design, and was criticised for its design by the RASE.

Another Yorkshire-based company – Walsh & Clark –

introduced a similar tractor for ploughing, again based on steam engine design conventions, including dummy chimneys. The 'boiler' was actually a large petrol tank, with the cable drum for ploughing carried beneath, just as in the old steam types.

Once the i/c engine designers got away from the idea that their product had to resemble steam tractors, two major advantages were seen. The petrol-engined machines were lighter, and more importantly, they were available for work immediately, whilst the traction engine was still building up boiler pressure.

One of the first home-produced petrol engined tractors was a three-wheeled design from Daniel Albone, of Biggleswade, which appeared in 1902. The lightweight design was built by Ivel Agricultural Motors Limited – it was intended for use in the field, and although weighing in at only 1.5 tons, it was able to pull a three-furrow plough and haul a binder or grass cutter.

However, it was Henry Ford who would make the greatest impact. His first design appeared five years later in 1907 and his company began mass production of tractors from 1917 – the first production models appeared in 1916 from Henry Ford & Son and of course were named 'Fordson' tractors.

Final flings

Although the writing was on the wall for the steam traction engine, those early petrol-engined tractors had their teething troubles, including susceptibility of fuel and ignition systems to the rigours of work in an agricultural environment. In the early years of the 20th century the steam engine builders produced lightweight steam tractors in an effort to narrow the gap between traction engines and tractors. But the continued development of the petrol engine, its lower cost and operational benefits would not be held back forever.

In a last fling perhaps, there appeared some curiosities amongst the steam engine designs that attempted to sway the farmers into allowing them on the land. One of these was the Summerscales steam

PHOTO 15: 50 years ago steam ploughing competitions were popular with preserved cable ploughing gear. This was at Marsh Gibbon in 1971 *Photo: Gerald Williams, Wikipedia Commons*

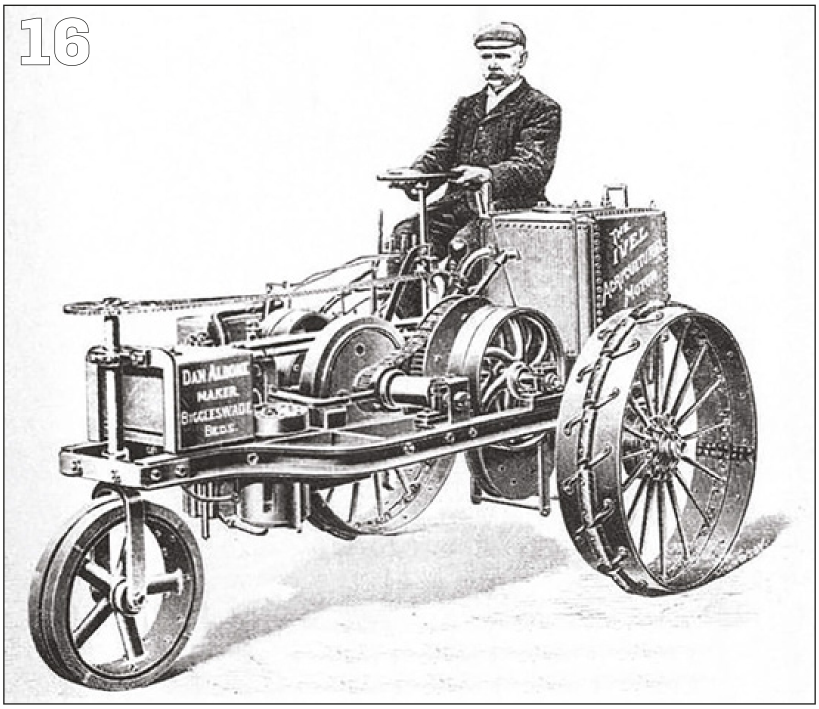


PHOTO 16: From the *North Bedfordshire Gazette* in 1903 shows the first petrol tractor built in the UK, 'The Ivel'. *Image: Wikipedia Commons*

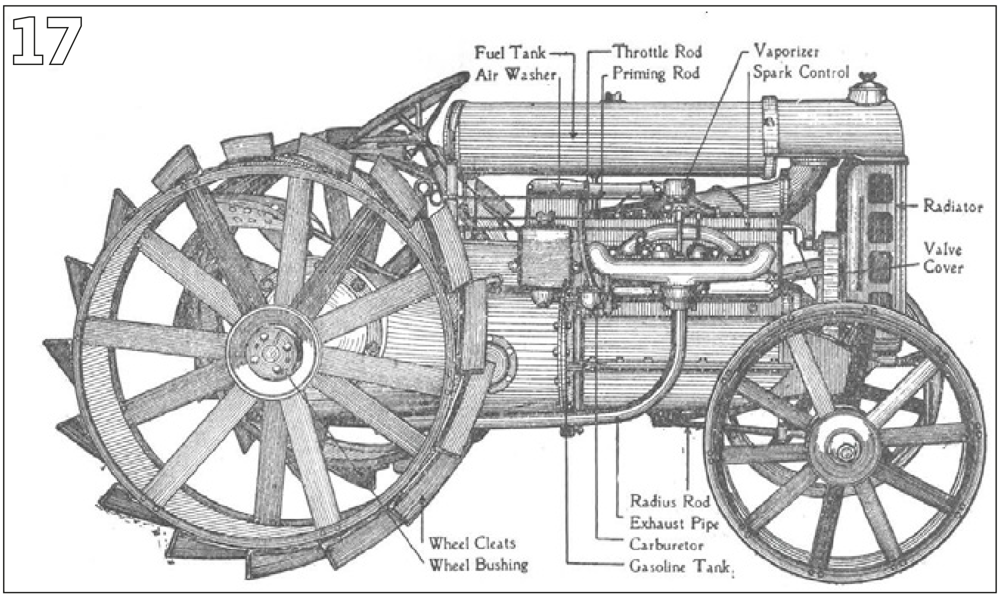
PHOTO 17: End of the road for steam engines came when the Fordson tractor arrived on the farm. This is one of the first Type 'F' models. *Image: Wikipedia Commons*

tractor, in which a vertical steam boiler supplied power to four cylinders arranged in a V-formation and operated by poppet valve gear. The final drive to the tractor's wheels was through a system of chains. Weighing in at four tons, and providing 25hp, it made its first public appearance in Lincoln in 1919.

Garrett's of Leiston was also busy with steam tractors at the same time, building the 'Suffolk Punch' to prove that the cost of steam ploughing could be competitive with the internal combustion engine. Garrett's design had a superheated boiler, a double-crank compound engine, Ackerman steering, two axles and coil spring suspension, with the tractor providing no less than 37-40hp. But, despite such advanced features it was unable to challenge the petrol-engined tractor's occupation of the number-one spot, and only eight were built.

In the early 1920s, the Fordson tractor was being imported into the UK for just over £200, and the outlook for steam power down on the farm was distinctly bleak. Even so, the Sentinel Company of Shrewsbury decided to enter the tractor market for the first time. Sentinel built a tracked vehicle known as the Sentinel-Roadless tractor in 1924, which despite its impressive power characteristics, at £1,250 was in no way about to challenge the petrol and diesel-engined tractors.

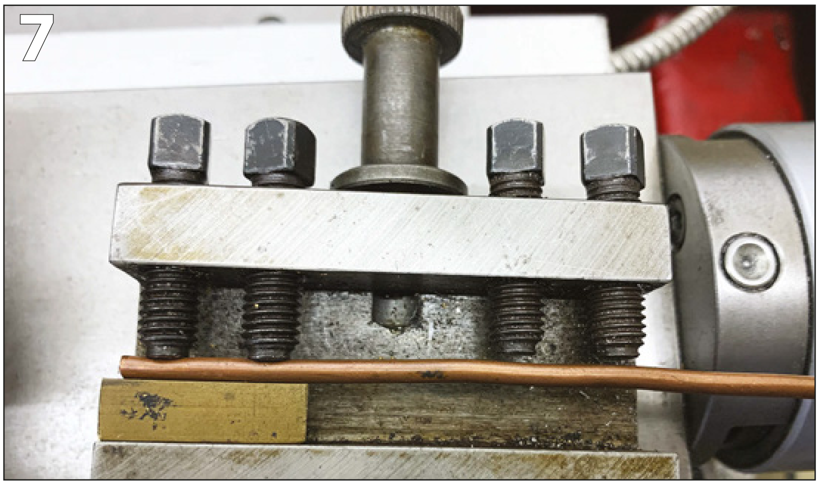
Had Sentinel entered the field earlier, even with wheeled vehicles, the firm may have developed some competitive edge with the Fordson and company. But Sentinel arrived too late to give steam traction any opportunity for an Indian Summer on the farm, as the petrol and diesel engines moved on to continue their success story. EIM



Rome wasn't built in a Day

Peter and Matthew continue to de-snag their Romulus-derived 'Maggie' 0-6-0 that they bought used, this month completing the redesign of the safety valves.

BY **PETER & MATTHEW KENINGTON** Part Two of a short series



Last month we began our adventure to de-snagg our used locomotive purchase, focusing initially on the safety valves, which were a bit of an odd design and when running on the track refused to reseat at a sensible pressure. Having modified the size of the ball bearings employed, we were then into producing new springs.

Construction of the springs proved surprisingly easy. We used 1.2mm diameter corrosion-resistant spring wire – clearly the wire needs to be resistant to corrosion and so standard steel spring wire should, ideally, be avoided. Stainless-steel or bronze spring wire would both be good choices, however these can be more difficult to obtain in exactly the right size.

Fortunately, springs fail 'safe' in this application – a corroded and hence 'weak' spring will release at a lower pressure than will a new spring. If the (or a) safety-valve needs adjusting significantly at your locomotive's next steam-test, then it might be worth checking the condition of the spring.

To make the spring, we used our Harrison M300 lathe and its threading gearbox. The spring wire needs to be fed to a former using a means which both directs the wire to the correct place and provides a little resistance, to ensure that the spring wire winds tightly around the former, once the lathe is turning.

Photo 7 shows the arrangement we used. It employs a lathe toolholder, a spacer (a spare piece of roughly

PHOTO 7: Spring-wire feed arrangement using copper tube and a suitable spacer mounted in a lathe toolholder.

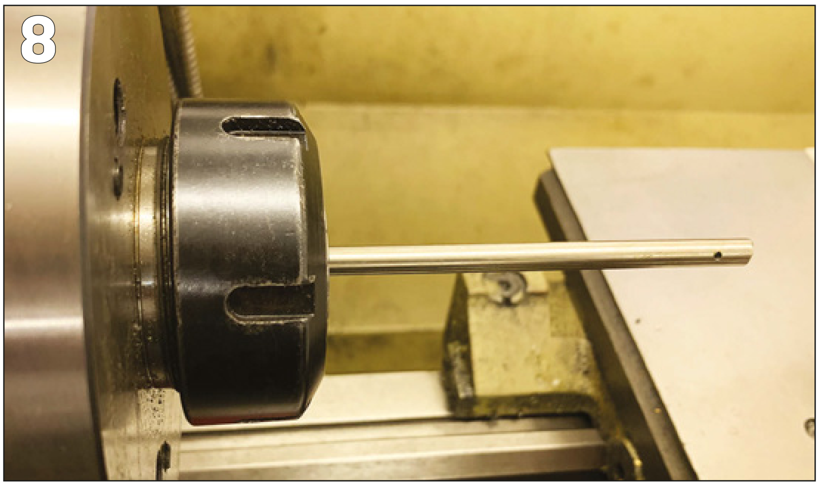
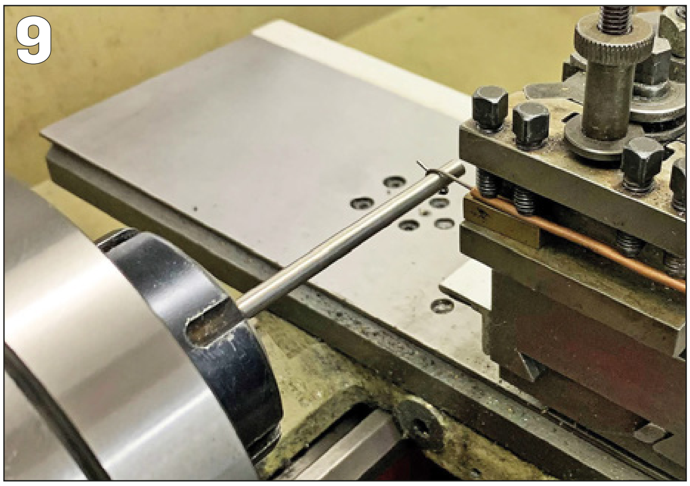


PHOTO 8: Spring former – a piece of silver-steel rod with a suitable size of hole drilled through it.



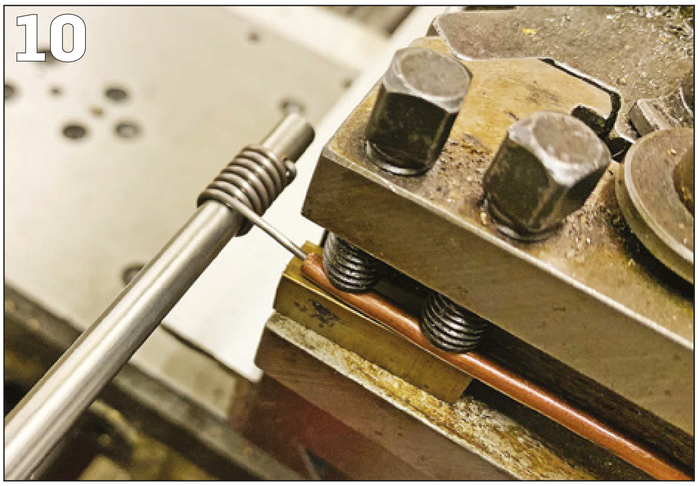
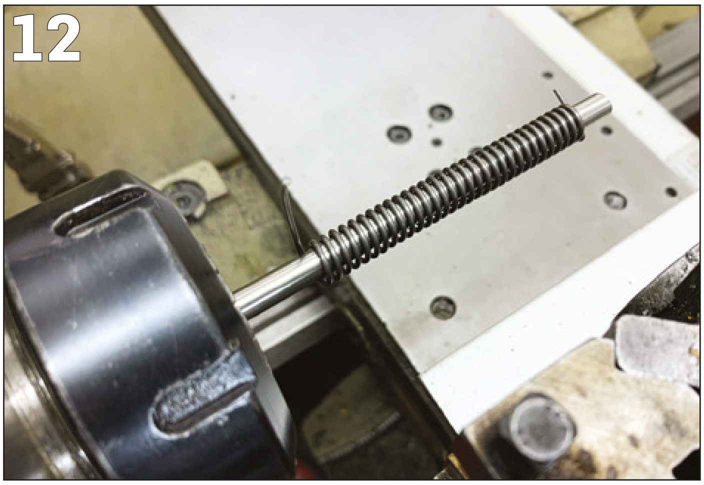


PHOTO 9: Starting turn added manually (or a longer stick-out of wire could be used).



square cross-section brass, in our case) and a length of copper pipe. If you plan to make a large number of springs using a particular diameter of wire, then it is worth making a pair of 'vice-jaws' (with suitable grooves to guide the wire) for fitting in a toolholder. For a one-off (or two-off, in our case) requirement, the arrangement shown is adequate.

The bolts on the toolholder should be tightened to lightly grip the wire, when crushing the copper pipe. The desired degree of friction is sufficient that the wire winds tightly around the former without bending it unduly. A little experimentation (turning the chuck manually) will quickly produce the correct setting without wasting much wire.

Photo 8 shows the former, mounted in the lathe chuck (with a rather larger stick-out than was strictly necessary!). The hole is used to retain the wire – insert it through the hole and bend suitably such that it will not pull out once the lathe is started. Photo 9 shows a 'first-turn' (applied manually) for this purpose.

Photo 10 shows the spring forming as the lathe runs. The lathe's threading gearbox is used to select the required number of turns-per-inch (TPI), as will be discussed below.

The speed of the lathe should be set to the minimum available and, ideally, reduced further by electronic methods, as this will give more precise control to enable the coiling process to be stopped at the correct point. By 'electronic means' I am referring to a variable-frequency drive (VFD) or an inverter, such as the single-to-three-phase inverter we have running our M300.

Photo 11 shows an 'aerial view' of the spring as it is nearing completion and Photo 12 shows the completed spring prior to removal from its former. Note that the diameter of the former needs to be rather less than the internal diameter required of the finished spring. A figure of around 20 per cent is a good starting point, although a little experimentation may be needed.

Photo 13 and Photo 14 show the settings we used on the screw-cutting gearbox, in order to obtain the required 14 TPI for our springs (the nearest available to our actual requirement). Note that on a metric-only lathe, the required 'thread-pitch' will need to be calculated and set on the lathe's gearbox. The required calculation is:

Thread pitch (in mm) = 25.4 / TPI

In our case this works out to be: 25.4 / 14 = 1.8mm

Stand Upright

'An upright spring is a fine spring'. It is very tempting to cut the excess wire off the newly-formed spring and fit it straight to the safety valve plunger (as the builder of the original safety valves had done). Whilst this is probably not catastrophic, it does mean that the spring will kink or bend as it is compressed, since the ends of the spring are far from square, and thus the inside of the spring will rub on the plunger rod as the safety valve opens. It will also tend to force the plunger to one side as it moves upwards in the hole in the top cap of the safety valve, potentially increasing the pressure needed to move it a sufficient distance to exhaust the steam. Given that it is extremely easy to square-off the ends of the spring, it seems criminal not to, thereby ending up with a spring and plunger which will operate as designed.

To do this, a former is required, otherwise the spring will flex whilst being ground. The former on which the spring was originally made is ideal for the purpose, although any other suitable diameter piece of stiff rod will do. We used a piece of silver steel, as we had some of the correct diameter lying around, although this was overkill for the required purpose!

Photo 15 shows the spring prior to grinding – this would work (probably) but is not ideal. To grind ▶

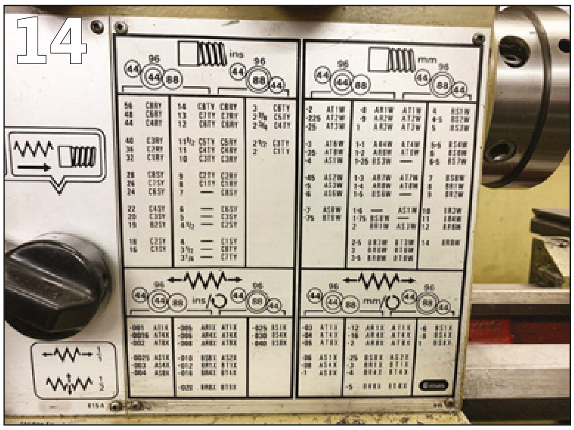
PHOTO 10: Spring-making underway, using automatic lathe feed (screw-cutting) settings.

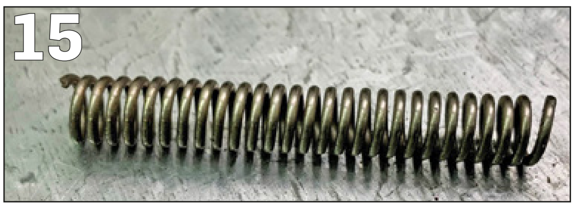
PHOTO 11: View from above showing feed system in use.

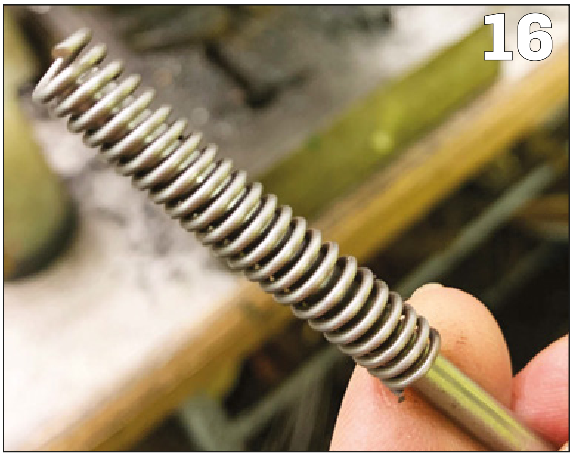
PHOTO 12: Completed spring – note that it has 'relaxed', meaning that the former needs to be smaller than the desired internal diameter.

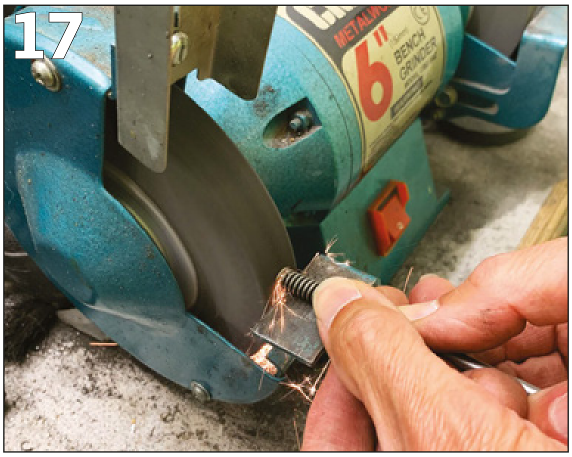
PHOTO 13-14: Threading gearbox settings used on author's Harrison M300 and corresponding table showing the resulting TPI achieved ('C8TY' = 14 TPI with gear combination set at present).

PHOTO 15: Spring before grinding.









the spring, place on a suitable former (Photo 16) and then carefully grind the ends of the spring (Photo 17) on a grinding wheel. The resulting spring is shown in Photo 18, standing proudly upright (to prove that the ends are ground square!).

New stems

The larger balls used in our improved design necessitated the turning of some new valve stems. This also afforded the opportunity to equalise the length of the stems on the two safety-valves (the originals being far from equal, as was shown in Photo 4 last month).

The dimensions of the new valve stems are shown in Figure 6. Both parts of each stem, the 'cup' and rod, were made from phosphor bronze.

The procedure used was first to face-off and then centre-drill a suitable piece of phosphor bronze rod (plus-12.5mm diameter) using a No. 2 centre drill ($\frac{5}{64}$-inch). This hole can then be drilled out to an M3 tapping size (2.5mm) to a depth of about 13mm (sufficient that the full diameter of the drill creates a hole of at least 10mm in depth).

The ball-socket can now be drilled using a ball-nose end mill (Photo 19) of the correct size (12mm in our case), to a depth of half the diameter of the ball/end-mill (6mm) from the front-face of the rod.

The outside of the piece can now be turned down to the required diameter – we chose 12.5mm, although we could have gone for a slightly smaller size here (Photo 20). This diameter should be small enough to allow the right amount of steam through the gap, yet large enough to totally encapsulate half of the ball

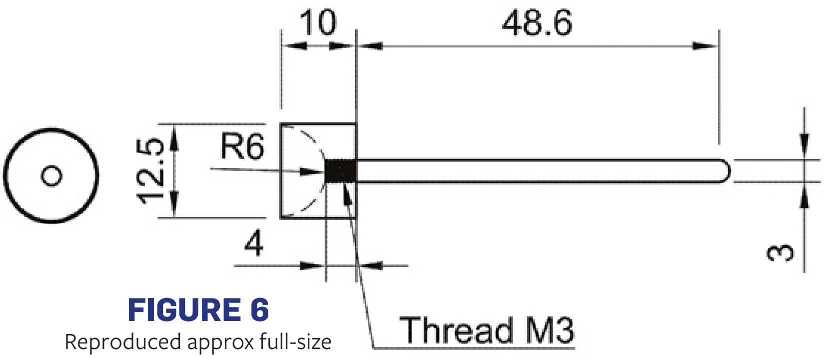


FIGURE 6
Reproduced approx full-size

PHOTO 16: Spring on former, ready for grinding – this first-made 'test spring' contains fewer turns than specified for final version.

PHOTO 17: Using former to guide the spring whilst grinding.

PHOTO 18: 'Upright' spring after grinding

FIGURE 6: New valve stem dimensions.

PHOTO 19: Using a 12mm ball-nose end mill to form ball socket for valve stem.

PHOTO 20: Turning the body of the ball socket from phosphor bronze bar.

(ideally), as was discussed earlier.

The ball-socket can now be parted-off to a suitable length. We used 10mm, to allow a thread depth of approximately 4mm to be used to attach the stem-rod.

The stem-rodding we used was already approximately the correct diameter and so we could simply thread this to M3 for 4mm and then cut it to the required length. Note that it is important not to thread too much of this rod (it is better, in fact, to thread too little, ideally). This is because we want the ball to seat nicely in its cup and not to be displaced slightly by a protruding end of the rod.

Equally, we want the rod to be tightly screwed into the cup, as we will not be able to 'Loctite' this component, since the heat of the escaping steam is likely to weaken or destroy the bond (unless a specialist high-temperature adhesive is used).

If the rod is threaded too far, then it is possible to rectify this either by filing a little off the threaded end or by threading the rod into the cup, putting both in the lathe chuck and re-applying the ball-nose end-mill to remove the excess rod. If you opt for the filing solution, a handy tip is to screw a nut onto the thread before filing and then to remove this afterwards. This helps to reinstate a usable thread on the filed end.

Photo 21 shows the completed assembly and Photo 22 shows the close-fit of the ball in its seat.

Safely re-installed

The only remaining task is now to re-assemble the modified valves and re-install them on the loco. Before doing this, however, it is worth 'seating' the new balls in the original ball seats. This ensures that they form the best possible seal under pressure and takes advantage of the fact that the stainless-steel ball bearings are harder than the phosphor bronze valve seats, which form a part of the safety-valve body.

Photo 23 and Photo 24 show this process. The first step is to ensure that the valve (or at least the inside of the valve body) is clean. This may be as simple as a blast with some compressed air or it may require the immersing of the body in vinegar for a few hours, to remove any boiler scale.

The reason for this cleaning process will now become obvious. The method of seating the balls is to 'tap' them into place, using a piece of wooden (or rigid plastic) dowel. This forces the (softer) phosphor bronze valve seats to conform to the (harder) stainless-steel balls. Only a fairly light 'tap' should be required – the 4lb lump hammer can go back in the drawer.

Once the ball has been seated, the valve can be re-assembled and re-installed in the loco (Photo 25). The newly-refurbished valves both operate well, blowing off at a smidgen over 80psi and maintaining this pressure even with the hottest and most lively of fires. They re-seat quickly and easily, within a few psi of their rated pressure and, crucially without taking the boiler down to the 40psi of their previous incarnations.

Re-seating safety valves

In the event that a safety valve does not re-seat perfectly, leaving a wisp of steam even though the boiler pressure is below the pressure at which the valve should re-seat, it is possible to 'encourage' it to do so, with a light tap on the portion of the valve stem protruding from the valve. Care should be taken when doing so, however, for the following reason.

The safety valve may well not be re-seating correctly due to the presence of a small amount of dirt or scale on either the ball or the valve seat. If this dirt is hard (whilst it is unlikely to be harder than the stainless-steel ball, it may be harder than the brass or bronze seat) a 'thwack' on the stem with a coal shovel may simply serve to embed the dirt in the valve seat, or permanently scar it. The valve will then permanently leak, unless the valve seat is re-ground.

A very gentle tap should be all that is needed and, ideally, with something soft – we have seen a gloved finger wrapped in a rag used, with care, although only on smaller valves/locos. This will re-seat a ball which is slightly off-centre, without inflicting permanent damage (either on the valve or the finger, hopefully...). If this does not satisfactorily re-seat the ball, then further investigation (and cleaning) is probably needed.

One down, many to go

So far, we have described one problem and its solution – it is, unfortunately (for us), the first of many issues. At the time of writing, we have solved most of these, but still have more to go. We will share all of our findings and solutions in future articles. Hopefully, our trials and tribulations will help others in their quest to turn a functioning loco into a wonderful loco, or at least an acceptable one.

As with many ancient stories, myths and legends, the tale of Romulus and Remus was revised many times throughout the centuries, usually to eliminate any embarrassing inconsistencies and to fit better with the times. In the same way, our Romulus has undergone a few changes and is undoubtedly the better for our efforts (so far). It certainly runs more smoothly than the traffic in modern Rome – perhaps not high praise. EIM

■ Should you wish to obtain a copy of part one of this feature published last month, issue back-ordering details are on page 9.

"A 'thwack' on the stem with a coal shovel may simply serve to embed the dirt in the valve seat, or permanently scar it. The valve will then permanently leak..."

PHOTO 21: Finished stem showing the ball seat.

PHOTO 22: Checking that ball fits nicely in the seat.

PHOTO 23: Seating the ball.

PHOTO 24: Using a wooden dowel to shape the valve-seat to fit the ball.

PHOTO 25: Refurbished safety-valves reinstalled on the boiler.

All photos and diagrams by the authors

Renovating a Myford ML7

Howard and Isaac decide on a British classic lathe as the first major machine tool in their workshop and strike lucky on the used market.

BY **HOWARD** AND **ISAAC TRENDELL**

Having purchased a model steam project which, on the face of it, appeared to be just a big reassembling job (*the Ransomes traction engine introduced in the June 2021 issue*), our original intentions were to arrange for any parts that required machining to be completed by friends or acquaintances with the relevant knowledge, experience and equipment available.

Both my son Isaac and I are new to model engineering, however, so instead we decided to use the project as a learning experience and the first place to start was to purchase a lathe and a mill. It also turned out that, on closer inspection, there would be a fair amount of components requiring fabrication for the project!

Following some research involving a couple of visits to model engineering shows and reference from the internet we settled on finding a Myford ML7 lathe. The Myford is a perfect size for the job (and our workshop), it's a very popular machine and parts, accessories and knowledge are readily available. Myfords are also British and built to last!

There are plenty of used units for sale at a range of prices depending on condition and how many tools and accessories come with the lathe – or you can buy a brand new one from Myford. You should expect to pay anything from £500 to £2,900 (plus VAT for a new one).

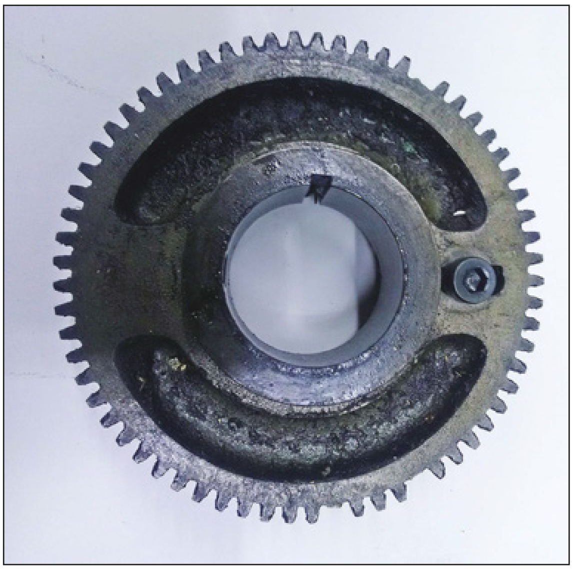
We found a lathe owned by a local chap who had taught himself metal turning in his shed and was selling his Myford as it had become surplus to his requirements. It had some issues but came with a selection of tooling and also some spare bar stock for us to practice on, so with a price agreed we loaded up the lathe and headed home.

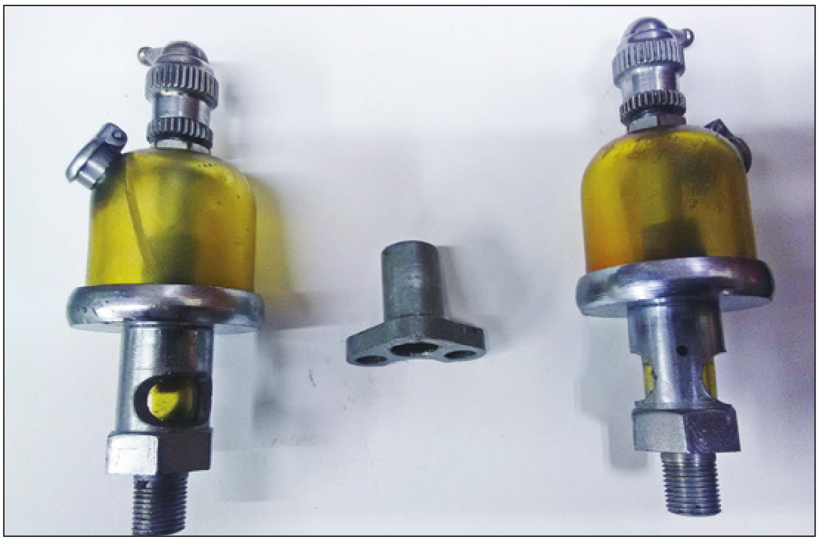
> *"There are plenty of used units for sale at a range of prices depending on condition and how many tools and accessories come with the lathe..."*

Few faults

An appraisal of the lathe at home revealed no nasty surprises and, luckily, what we saw prior to purchase was what we had bought. The main issue was a broken bull gear, caused by locking the lathe gear train to remove the chuck – something that is very much not recommended.

The lathe was also suffering from excessive backlash in the cross-slide adjustment, broken oilers, play in the drive pulley shaft and a good deal of swarf and dirty oil mixture coating most of the surfaces.





It was clear that a strip-down was in order, followed by a good clean and then reassembly with new parts where required. We completely dismantled the Myford down to its component parts and fully cleaned all the pieces, this gave us a good idea of the internal condition that was previously hidden when it was built up. We were happy to see that the nasty surprises continued to stay away.

Following a complete clean and degrease we began to reassemble the lathe, rebuilding the headstock with a new back gear assembly. As the machine had proven to be in such good overall condition, the reassembly was quite straightforward. All the parts needed were sourced from the Myford company except for the worn imperial cross-slide nut which is not readily available. Viewing the Myford Lathes Facebook page we found a useful source of new nuts from a 'man in a shed' making his own replacements! The driveshaft play, meanwhile, turned out to be a loose grub screw and worn indent which was easily rectified.

Secure mount

Once reassembly was complete the next task was to mount the lathe on a sturdy base. It is generally advised that the more rigid the lathe the more accurate the work will be, this starts with a good stand to reduce vibration and bed deflection during use.

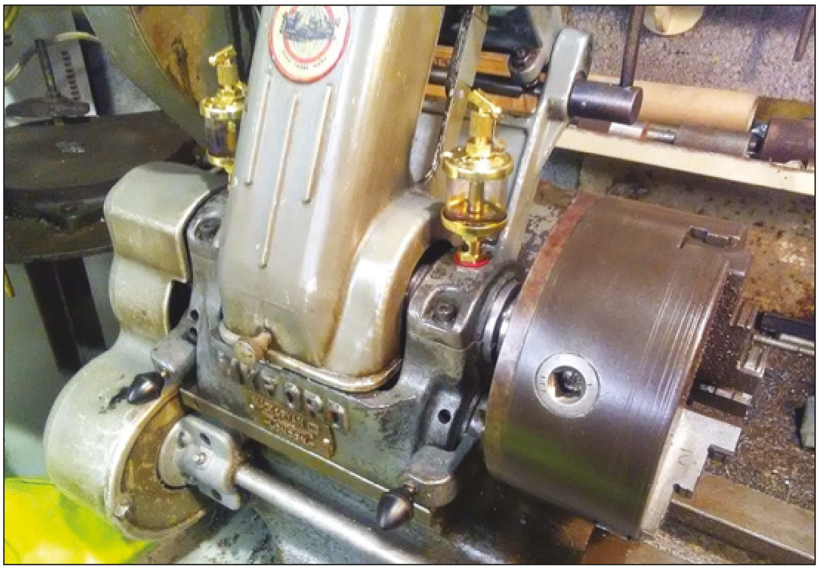
The most ideal option is a genuine Myford lathe stand but, as we don't yet have one of those, a sturdy steel bench that was surplus in our workshop was screwed to the floor and the wall – it provides a good alternative. The Myford was bolted to the bench through the oil tray which incorporates a pair of riser blocks to allow adjustment of the lathe bed.

Adjustments were made to the gib strips on the cross slide, top slide, tailstock and the shims on the headstock bearings to ensure that any free play was eliminated which is essential for accurate work.

A full lubrication was also carried out using 32 grade oil; absolutely NO grease! We were now ready to set up the lathe using the prescribed method given in the Myford operators manual.

To ensure that when turning stock you end up with a parallel work piece the lathe bed must be adjusted before first use. To achieve this a steel bar approximately one inch in diameter and six inches long is mounted in the chuck and, without using the tailstock to hold the other end, two shoulders are machined in the bar, one at each end. The measurement with a micrometer of the diameter of the two shoulders will indicate if the lathe bed is true.

"The more rigid the lathe the more accurate the work will be, this starts with a good stand..."



If a taper is detected, then the bed is lifted or lowered by the use of adjusting bolts through the riser blocks holding the lathe to the oil tray. To carry out this process you need some patience and to be left alone as it can be a very frustrating job but also very rewarding once complete!

Any secondhand lathe is going to require some renovation work and adjustment before first use, especially one that is very old. It is a testament to Myford build quality that a unit from the 1950s having seen considerable use over the years is in such good condition and ready for many more years of use. A number of simple components have already been manufactured and we are learning new skills. **EIM**

PHOTO 1: The Myford fully stripped for inspection.

PHOTO 2: Broken bull or 'back' gear teeth.

PHOTO 3: Damaged oilers and worn cross slide nut.

PHOTO 4: A batch of homemade cross slide nuts.

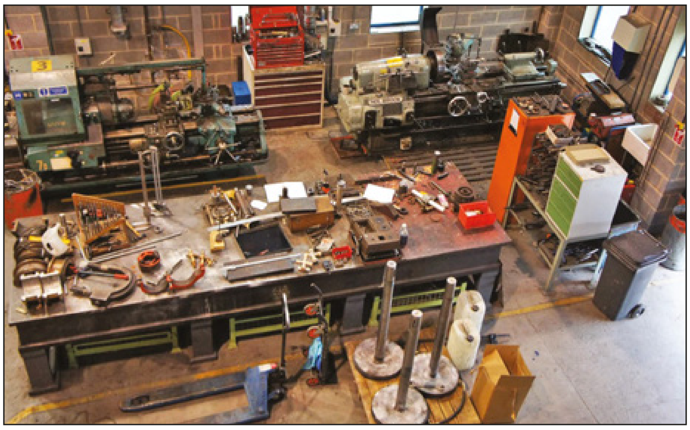
PHOTO 5: New modern equivalent oilers ready for fitting.

PHOTO 6: The Myford mounted on a sturdy steel bench.

PHOTO 7: Lubricated, adjusted and ready to go.

PHOTO 8: Checking for level setting – machined bar measured at both ends.

All photos by the authors



Concern at axing of NRM workshop

The UK's leading rail museum no longer has on-site engineering facilities after the closure of the workshop at the National Railway Museum (NRM) in York.

The space formerly occupied by the workshop is to be turned into 'Wonderlab', described as "a dynamic, dramatic and multi-sensory gallery to help visitors think and act like engineers". It will we are told inspire visitors to "make things work and work better when they play with 20 interactive exhibits".

York Model Engineers newsletter editor and regular EIM correspondent **Roger Backhouse** sent us the pictures on this page as passing by the museum on 11th November, he witnessed the machine tools being cleared from the workshop.

Tools moved out included an Elliott vertical slotting machine formerly employed in York carriage works, and a Webster-Bennett vertical boring machine. Thankfully both are set to find further use in a heritage environment at the Strathspey Railway in the Scottish Highlands – Roger commented; "These machines are now over 70 years old and heritage engineering in their own right."

He added that previously visitors to the NRM could see activities in the well-equipped workshop from a viewing gallery, including work on such high-profile locomotives as LMS Princess Coronation class 4-6-2 'Duchess of Hamilton' and GWR 4-4-0 'City of Truro'.

"It was always popular, giving a realistic picture of real-life railway engineering now lacking from a much more antiseptic museum," Roger said.

According to local newspaper *The York Press,* Yorkshire-based artist Pippa Hale has been commissioned to 'create a headline installation for the family-friendly gallery' that will 'feature a collection of large interactive blocks that would encourage visitors… to design, build and play together.' An unimpressed Roger commented that though there will be other interactive exhibits, "this hardly sounds sophisticated.

Engineering principles

Roger told us that following a letter he sent to the local press, an NRM spokesman insisted that Wonderlab would not be a playground but routed in engineering principles, and that the museum would have another workshop, though he could not say where. Apparently visitors to the museum are asking regularly at the reception desk why the viewing gallery is no longer open.

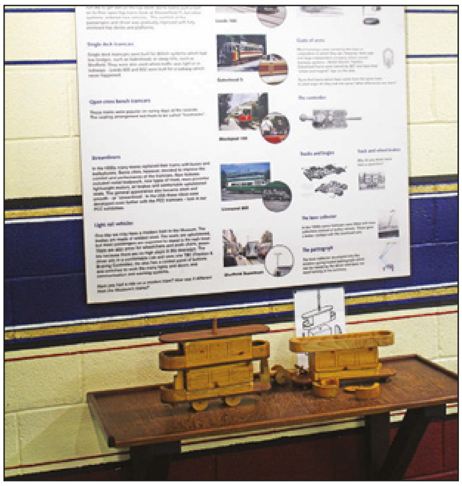
"It is hard to see how this can make up for losing the practical engineering expertise at the museum," Roger added. "Whatever the merits of Wonderlab the loss of these significant workshop facilities is a major loss to British railway heritage and preservation."

EIM editor Andrew Charman comments: This is indeed depressing to hear but sadly indicative of the way things are going with many museums, fine and informative views and displays being increasingly replaced by 'interactive' activities that in many cases seem much more focused on replicating video games with buttons to press and screens to touch than telling the important story of the museum concerned.

Certainly on my most recent visit to London's Science museum I was saddened to see so many fine and detailed models of long-lost engineering items having been replaced by interactive activities with little or no historical provenance.

It can be done very well – in my opinion a standard bearer for how to tell historical stories to all ages is the Crich Tramway Museum in Derbyshire. Here there are plenty of interactive activities for the youngsters but without losing the traditional historical material for adults – and often placed alongside or on top of each other so that while the younger visitors are occupied with activities, there parents are given time to enjoy the information that interests them.

It can be done, with a little thought...



ABOVE: Views like this from the NRM workshop viewing gallery are no longer possible.

LEFT: Machine tools including an Elliott vertical slotting machine circa 1950 and a Webster Bennett vertical boring machine are being moved out. *York photos by Roger Backhouse*

RIGHT: Crich has found an appropriate way to cater for all ages. *Photo: Andrew Charman*

Trying to trace Britannia called 'Ariel'

I am writing with regard to a 3½-inch gauge model of the Britannia 4-6-2, named 'Ariel', number 70016.

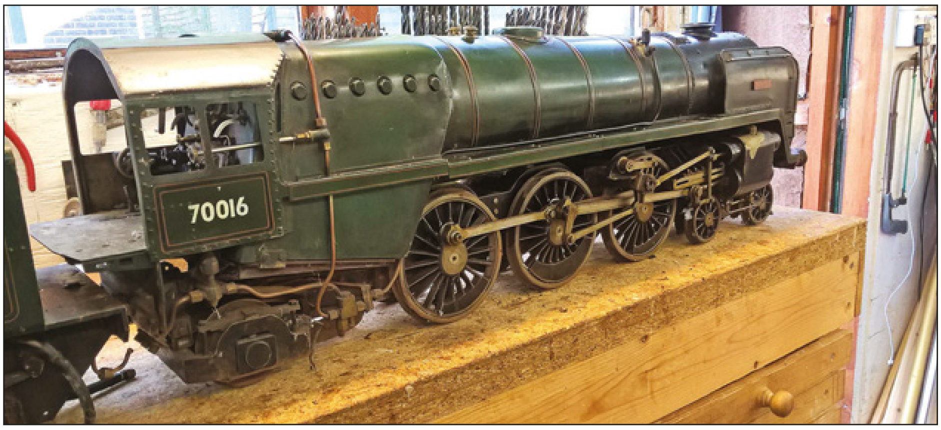
This locomotive was built by my father Len Cole, and ran mainly at the Guildford club track at Stoke Park in Surrey.

I had the loco for many years, and then sold it a few years back along with a 3½-inch gauge Black 5, to a member of the Sussex Miniature Locomotive Society at Beech Hurst in Haywards Heath, Sussex.

I understand that he subsequently sold the model, and I have now lost track of it. I would love to find out if it is running again, as my grandson is very keen on steam locos both full-size and models.

I wonder if it would be possible via your magazine to try to trace the model – anyone with information can contact me via my email below. Thanks for any help you may be able to give.

Barry Cole
modelgliding@aol.com



The Governor – Controlling the Power of Steam Machines

By John Hannavy

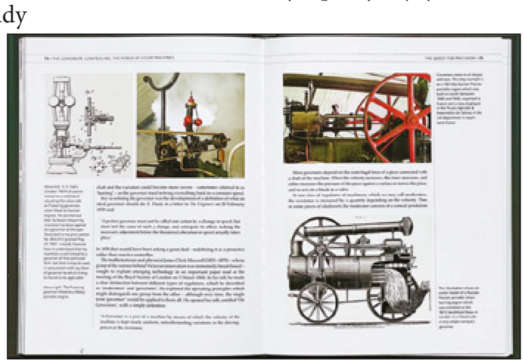
A 160-page hardback book focusing on one particular component of the road and stationary steam engine? It may seem initially a bit of overkill, but the author makes a firm case for the importance of the governor right from the start – "Power without control is unusable power, and long after the invention of the steam engine, finding ways of applying that power to tasks where consistency was of paramount importance was the 'Holy Grail' which many steam engineers sought..."

What follows is the most intensive study of the steam engine governor you are ever likely to find – John Hannavy has clearly spent a great deal of time and effort in researching his subject.

He traces the story of the centrifugal governor right back to its origins in 17th century steam, looking extensively at the work of James Watt, and then follows the progress of the device as it evolved to meet ever greater demands of more powerful engines – during the 19th century alone more than one hundred patents documenting improvements to governors were applied for in the UK.

All these improvements are described in detail, while the text is greatly enhanced by a host of period diagrams and large colour pictures of excellent quality, showing clearly how this component evolved. There is even a final chapter listing places governors can be seen working today.

Sceptical at the outset, your reviewer found this book interesting and one which EIM readers will likely equally enjoy. ***AC***



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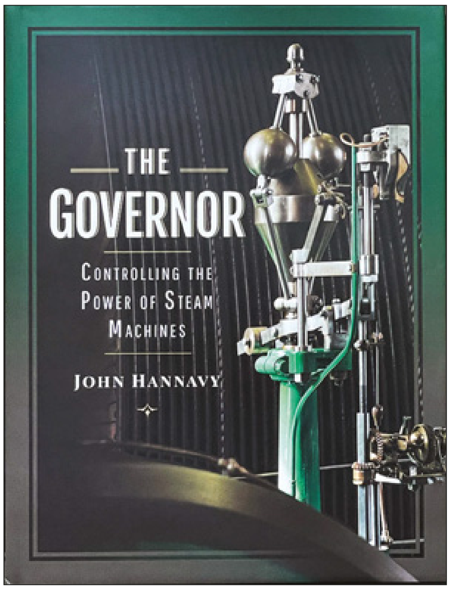


Media surprises, firework delights

As the clubs look forward to hopefully a less disruptive new year, the old one is ending with some surprises and successes too...

BY **ANDREW CHARMAN**

Welcome to this month's club and track news round-up, as we look forward to hopefully a much more active year in 2022 and a return to many more events and particularly shows – though sadly as we know we again start the year without the traditional London exhibition at Alexandra Palace. I'm sure I'm not the only one who regrets the absence of this show, always a most welcome post-festive day out, even from the wilds of Wales, and starting the year in a positive way. We can only hope for the event's return in 2023.

Having said that we still can't get away from the fact that normality is still some distance away. As I write these words concerns are mushrooming over a new Covid variant called Omicron (who chooses these names?) and it is disappointing to read in the latest newsletter from the **Bournemouth & District SME** that the AGM planned for 1st December has had to be called off for a second year, due to the planned venue reacting to growing Covid numbers by cancelling all its meeting bookings. We also know that several clubs still don't feel able to stage their Christmas parties this year, a shame as these are important social occasions for many a club member.

In the Eye

Meanwhile, of all the jobs that come with editing a model engineering magazine, I never expected one of them to be writing to the editor of *Private Eye* magazine! But just that was necessary this month to obtain permission to reproduce the cover of the satirical magazine's latest edition, which took aim at the Government's latest plans for the HS2 high-speed rail network. Clearly an Eye minion was dispatched to find a suitable picture of a miniature railway and several of our readers quickly identified the line in question as the track of the **Hereford SME** at Broomy Hill, the picture apparently taken some years ago!

Mentioning *Private Eye* immediately reminds one of that magazine editor's other major claim to fame, Ian Hislop of course being one of the resident team captains on the BBC's *Have I Got News for You*. It has been commented to me in the past that **EIM** might be a candidate for the 'Guest Publication' slot in the 'Missing Words' round of this show – for those who don't watch it the publications featured tend to be the more specialist and unusual in the market...

Actually **EIM** has never been asked, but I can reveal that its sister magazine *Narrow Gauge World*, which I also edit, was contacted, twice! I sent them lots of relevant material but we've never appeared – perhaps we were a little too normal...

Blazing success

Back to more familiar publications, and the cover of the latest edition of *The Blower*, newsletter of the **Grimsby & Cleethorpes ME**, features a dramatic picture taken at the club's recent Bonfire Night public running, and serves as a reminder that the ability to run late-season events such as this have been very welcome to many a club still recovering from a year in 2020 with little or no revenue from offering train rides to visitors.

The front-page headline on *The Blower* (of which the apologetic editor admits is a bit too "tabloid") attests to the success of the event, and within the issue member Tom Burton describes it as "a fantastic evening," during which the club carried a record 1281 passengers in just three and a half hours, using five steam locos and four three-car train sets. That is certainly impressive...

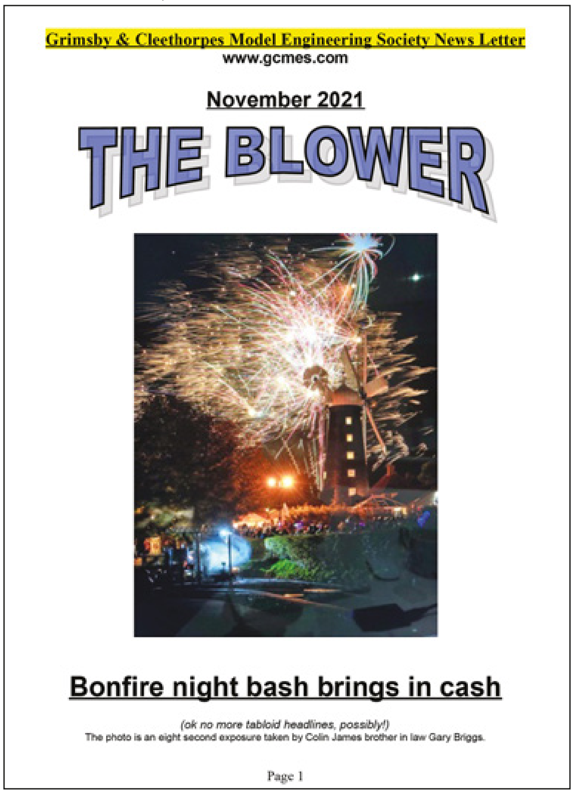
In the same issue chairman Geoff Morgan reports that despite a much shorter public running season in 2021 income has been very strong and ahead of both the previous two 'normal' seasons in 2018 and 2019. Other clubs have reported similar performances this season and it's good to hear – clearly the public has been determined to get out and about this year after the lockdowns of 2020 and our miniature railways are benefiting.

Such funding successes are important as most if not all of the clubs have improvements and enhancements to make and they cost money! Grimsby projects include a new station canopy which is set to cost around £5,400 – significantly more then when the project was first planned and a sign of these challenging times financially.

Your editor also found particularly interesting an apparently enthusiastic discussion between Grimsby members on the possible benefits of hydrogen as an alternative fuel to petrol and diesel.

Send club news, dates and pictures to the editorial address on page 3.

This is a subject I'm increasingly writing about in my 'other life' (yes, I have one), as a motoring journalist, with a growing number of automotive manufacturers considering that fuel-cell vehicles, powered by



hydrogen and with their only emission being water, have a role to play alongside (not replacing) electric vehicles – interesting times...

Not everyone, however, wants our railways to be too successful as an amusing note in the *Branch Lines* newsletter of the **West Riding SLS** records. A lady visitor at the club track was asked if she had been before and she said she had, many times pre-Covid, and had discovered the track was running again when a friend shared the club's reopening message on Facebook. But when asked if she had shared it too she replied "Oh no, this place is nice and quiet and that's how I want it to stay..." The power of social media...

Also notable in the West Riding newsletter is chairman Bob Richardson's report on the success of the club's newly constructed garden railway, in 32 and 45mm gauges, which Bob describes as "an impressive layout justifying the hard work that went into it." He adds that the availability of this layout has seen the club gain several new members "representing the diverse interest of model engineering." Couldn't put it better myself, as regular readers will know I bang on constantly about the relevance of the smaller scales to our hobby, with much fine model engineering being conducted and some being encouraged to build something bigger after completing successful projects in Gauge One, 16mm or similar.

Talking of the smaller scales, "everybody loves a tram engine don't they?" opines Roger Backhouse, editor of *The Newsletter* published by the **York ME**, and he goes on to suggest this may be due to the Reverend W Awdry and his creation of Toby the Tram Engine in the *Thomas the Tank Engine* books.

Tram trio

All of this serves as an introduction to three separate tram engine projects constructed by York members, two based on and all three inspired by the 'Ellie' concept. As we have reported in these pages in past editions, Ellie was conceived as an easy-to-build steam loco in 16mm/G scale with the aim of both attracting new builders and giving those looking for a quick lockdown project something to build – a construction book, and many of the parts needed are available as laser-cut components along with a complete boiler from Camden Miniature Steam Services (www.camdenmin.co.uk).

Particularly impressive among the three projects is the one pictured on this page, built by Mike Keeton and which used the Ellie construction manual as inspiration but was then adapted by Mike to represent locos he viewed in another book on a famed garden locomotive builder, Peter Angus. The most obvious difference is the use of a single-flue vertical boiler, unlike the horizontal format one of the stock Ellie, and with its rivet detail Mike has certainly created a fine-looking model.

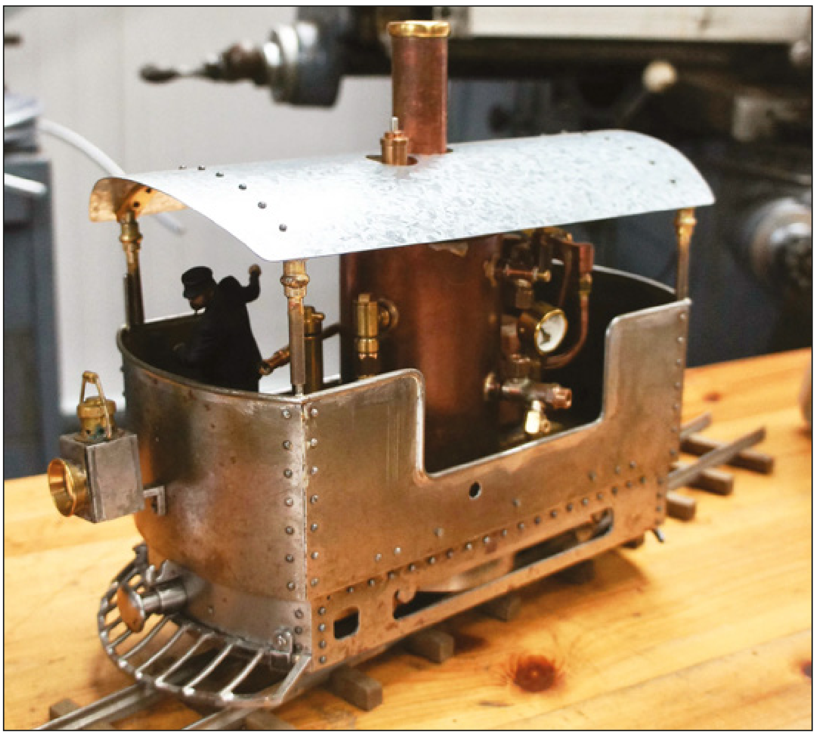
More public running success reported in the latest edition of *Trackerjack*, the quarterly newsletter of the **Teesside Small Gauge Railway**, at the Preston Park Museum in Stockton-on-Tees. "The public really welcomed the reopening of the track in August," the newsletter states, adding that fare takings since have been very good. While adding that it takes on average two hours to set up the track for public running days the report concludes; "one only has to look at the children's faces as they board, ride and disembark to make it all worthwhile." Amen to that – many ▶

"One only has to look at the children's faces as they board, ride and disembark to make it all worthwhile..."

FACING PAGE UPPER: Much surprise at Hereford to be starring on the front of this publication...

FACING PAGE LOWER: ...while Grimsby's latest newsletter offers a dramatic demonstration of a recent successful event.

ABOVE & ABOVE RIGHT: West Riding's new garden layout has helped boost membership. *Photo: John White/WRSLS*



RIGHT: Tram engines are all the rage right now, this attractive loco built by York member Mike Keeton. *Photo: York ME*

ABOVE: Paint touch-ups on the Centurion bridge. *Photo: Centurion SME*

a model engineer can look back to being first inspired by rides on miniature railways at a young age.

Club newsletters often yield fascinating pieces on techniques and solutions to problems, and in the case of Teeside member John Palmer needed to replace the grate on his 5-inch gauge 'Sweet Pea' and decided to make a rosebud version. Don't know what a rosebud grate is? In simple terms instead of having slots to provide air to the fire and for ash to drop through (what on larger and full-size engines are separate firebars), the grate 'plate' is covered in cone-shaped holes, a total of 131 in the example of John's Sweet Pea and the cones achieved by use of a centre drill from underneath.

So a lot of effort, but according to John worth it – his old cast-iron grate used to glow cherry red when the loco was in steam, whereas the new grate apparently stays much cooler with no effect on performance.

John now plans to make rosebud grates for his other locos, which leads us to ask, have other readers tried this form of grate and if so, why not tell your fellow readers about it?

A quick continental hop this month to South Africa, a prolific model engineering nation, and leaping out of the latest issue of *The Centurion Smokebox*, newsletter of the **Centurion SME**, is the large, newly painted and very red swing bridge on the club track. Why a swing bridge? Newsletter Jon Shaw explains; "Our track encircles at a higher level a maintenance area that houses rubbish skips and building materials, parking and such like. Access to the area is limited in height to about six feet under the bridge allowing only pedestrian or car access. So the bridge swings open for lorry access."

Jon adds; "The return line to the station passes under the bridge left to right on the far side of the central support. Lorry access is to the near side of the support."

A practical solution to a problem and a very impressive one too – we can imagine many a Centurion train pictured on the bridge.

Still in South Africa, the latest *Maritzburg Matters* from the **Pietermaritzburg ME** emphasises the enthusiasm for model engineering over there, editor Martin Hampton in his editorial listing some seven major projects members have underway, plus many more. Perhaps most impressive is member Bob Richardson who is apparently almost ready to light a fire in his 2-inch scale Minnie traction engine, after just a year's work...

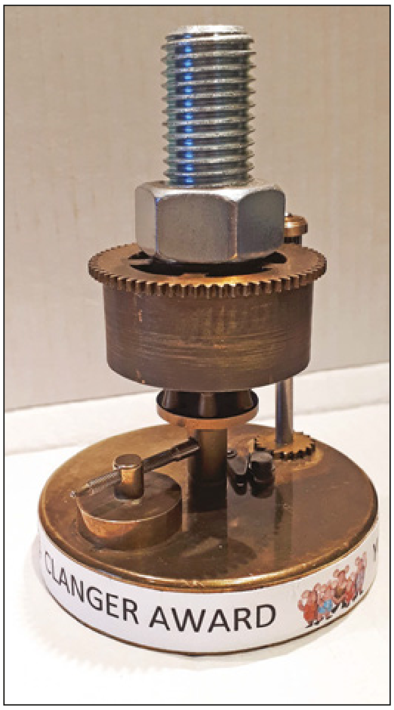
Dropping a clanger

To end on a light note we return to the York newsletter and the newly created 'Clanger Award', which as pictured on this page even has an impressive (?) trophy to win!

The idea was that of club member Bob Lovett who felt there ought to be a recognition of the 'clangers' we all drop. "We are, after all, only human," Bob says. "I know in my own workshop the old adage of 'measure twice, cut once' has long been replaced with 'measure five times, almost start to cut, measure again'. They say confession is good for the soul, but clanger confession can also be a source of much-needed source of amusement for others..."

The trophy was inspired by Bob's own error of completing a gearbox rebuild on his Triumph Twin motorcycle and conducting a successful test run, only to find a pool of oil under said bike a few days later due to the gearbox oil drain plug and its level plug both being secured only finger-tight... "Not clever, just imagine if they had vibrated out completely when riding," Bob said.

Hence the trophy, which comprises a design for a motor-driven self-tightening drain plug – ingenious! And York newsletter editor Roger Backhouse is the latest entrant trying to win it, entering the 'roll of dishonour' courtesy of the image on this page of half a drill bit holding together four unfinished bronze nuts rather like a kebab... Apparently the drill stuck and then broke when Roger took somewhat drastic action trying to remove it. We've all been there... **EIM**



RIGHT: The York Clanger trophy, and an entrant... *Photos: York ME*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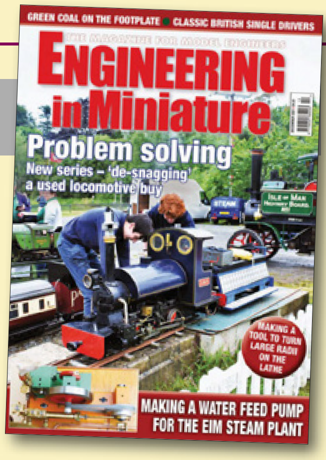

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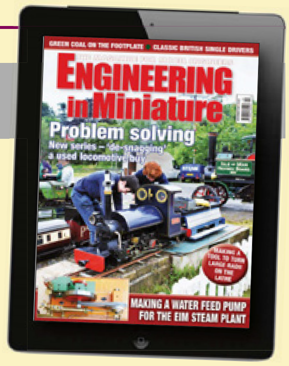

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